THE

# ELECTRICAL REVIEW.

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## THE CONDITION OF THE ELECTRICAL INDUSTRY.

IT is somewhat of a departure from a time honoured observance to consider the state of the industry at any other time than at the close of the year, but we think the peculiar conditions surrounding electrical work at the present moment justify us in making some remarks. To say that trade has been bad during the past nine months would not be quite just, for although there has been unmistakable depression in some branches of the industry, we believe the majority of firms have had their workshops fully employed. It would be curious if it were otherwise, considering that the many new central electric supply stations must have created a considerable, if temporary, demand for electric light and auxiliary machinery. Naturally enough with local authorities utilising their provisional orders, this demand will continue to exist; the electrical industry may consequently expect from this cause alone a certain prosperity for at least a few years to come. But in spite of the rapid extension of electric lighting, and the abundance of work which it necessarily brings to the electrical contractor, we really question whether the state of the industry was ever more unsatisfactory than it is at the present moment. There is a cause for most grievous complaint among the manufacturers, and though they are naturally reluctant to admit difficulties in the way of doing business, great difficulties do exist, and have to be reckoned with.

The keenness of competition, which at the present moment prevails throughout the industry, is felt in more or less degree by everyone connected with it. This competition, which has now reached a most acute stage, is responsible for a questionable lowering of prices in every branch of business. The cutting down of prices is carried on to such an extent that the narrowest margin of profit is left; not only is there an absurd lowering of prices all round, but in many instances the acceptance of tenders must have resulted in actual loss. We have time after time given instances in our columns of the extraordinary differences between the estimates of various firms tendering to a given specification. It is to be feared that the motive, which impels many firms to undertake work at ruinous rates, is advertisement. There are many notorious examples at the present moment of work being done at a loss, simply to attract attention. This form of publicity is not one likely to result in much good, and is as illegitimate as it is absurd. It is a method of doing business which will be fraught with the most disastrous consequences to all concerned. This pernicious system must gradually tend to the use of poor material and indifferent workmanship, and let this bad workmanship result in a few startling accidents, duly commented on by, generally speaking, a visionary and venial press, and the electrical industry may receive a blow from which it might not recover for years. There is another matter which

must not be lost sight of: this too keen competition will assuredly have the effect of landing into disaster the unstable members of the industry. We do not wish to reiterate some of the time-worn precepts of political economy, but we wish to point out that these precepts are singularly self-evident in the case of many electrical firms. It is only reasonable to suppose that large firms with first-rate organisation and more efficient means of manufacture are able to do work at a lower rate than the struggling firm with a small *clientéle*. Under these circumstances it is foolhardy, on the part of the small firm, to quote lower prices in the anticipation that future work will yield sufficient to cover a temporary loss. It is no uncommon occurrence to find in a list of tenders some three or four of the largest firms quoting within a few pounds of each other for large work, and smaller firms offering to do the work for, perhaps, two-thirds of the price at which more responsible firms would undertake it. Such a state of things is almost incredible, and the only possible solution is to be found in the desire to attract the attention of the general public. In all this it must be remembered that we are speaking of the manufacturing business generally. Certain branches of the industry are at the moment suffering more from the effects of keen competition than others. A few days ago a well-known dynamo maker remarked to us that his firm considered, when tendering, that if they added 10 per cent. to the total works' cost of a dynamo, they would expect to lose the order. We might be advised that this statement should be received with certain reservations, for the works' cost would no doubt vary in different workshops, but in this particular instance we are disposed to take the statement as very fairly representing general conditions, for it emanated from a workshop possessing good organisation and special facilities in the way of acquiring raw material.

We cannot help thinking that the electrical industry is rapidly undergoing some fundamental changes. The conditions under which we are working at the present moment are vastly different to what they were some three or four years ago. At that time there were no systems of electrical supply worth speaking about. But the building up of the numerous systems which now exist, must have been attended with considerable profits to those few engaged in the work. These favourable conditions are, owing to competition, rapidly altering. It is difficult, not to say risky, to hazard a forecast of what the future has in store for the industry; but we are convinced that in the near future contracts will generally find their way into the hands of the few really large firms, and the smaller ones will be slowly crushed out of existence. There will be, so to speak, a weeding out of the financially unsound, and it would be mere blindness to imagine that there are no weaklings in the industry. We do not for a moment suggest that the day of small firms is past, because many no doubt will flourish and do good business; but where they come into direct contact with the more powerful contractors, they will have little chance of success. Yet there are many small firms at the present moment vainly endeavouring to do business in open competition with the strongest combinations. They survive for a time, but they are fighting against a relentless fate. The large and financially powerful houses have been greatly affected by this spirit of change which has come over electrical work.

Up to quite recently, such firms as Messrs. Siemens, the Brush Company, and Messrs. Crompton, were not only manufacturers, but designing engineers. A very large proportion of the large central stations which were first put down, and which are now working satisfactorily, were designed by the engineering staff, and the work afterwards carried out by each firm, and no doubt in the past a considerable share of profits was earned in this manner. The customers practically paid at the same place for engineering skill, as well as for materials and reputation for good workmanship. All this has now been altered, and the consulting engineer now fills an important function in all large work. He sends out minute detailed specifications of the work to be carried out, and the whole of this work is offered to competition, and the only chance of success in obtaining contract work in such competitions is by cutting the prices low, so low, in fact, that there is not sufficient margin to enable any manufacturing firm to continue the payment of an engineering staff. No doubt the work when complete will cost as much under the present system as it did in the past; but the sum paid by the consumer will be divided among the consulting engineers and the contractors.

The older system still prevails on the Continent of Europe. Such firms as Siemens & Halske, Schückert & Co., Ganz and Co., and others, still compete for the lighting of the various large towns, as occasion arises, and no doubt the result of the present English system will be that the larger English contracting firms who have still good engineers in their employ, will be compelled to try more for foreign and colonial contracts than they have hitherto done.

In the subsidiary branches of electrical work, such as the erection of wiring, fittings, &c., which form a very important part of the industry, keen competition is rife. It is this branch which has attracted hosts of house decorators, art fittings' people, and the like; ironmongers, too, have thought it a legitimate field in which to exercise their somewhat latent talents. We are not certain that some of these artificers are not well adapted for this class of work; but be this as it may, they have helped to swell the number of those dependent for success on wiring and such like work. It is in this branch that the effects of bad workmanship are soonest felt, and it is in this branch that the system of absurd competition mostly flourishes. Here we find the desire to attract notice by a first piece of work carried out to an inordinate extent, and we are afraid that many of the newer and inexperienced firms are not beyond the temptation of putting in bad work. In this respect, we are not sure whether a weekly pillory of firms capable and responsible for bad work might not serve a useful purpose. Were it not for the fact that these things have a way of adjusting themselves, we might attempt it.

Looking round over the whole range of the industry, with a view to elucidating something of the prospects of work, we have come to the conclusion that in spite of the many present difficulties, it is but just to take a hopeful view of the situation. There may be many affected by newer conditions of work, but success will be attained by some, and those who are most successful in making internal economies will be the fittest to survive. At the present moment, however, the industry is too much divided. We would hail with satisfaction any attempt on the part of manufacturers to consolidate their interests with the object

of obtaining prices for work which would allow a fair margin of profit. Anything in the nature of rings and monopolies stirs up our opposition, but it would be perfectly legitimate, where possible, to have standard prices throughout the trade, which would be binding to all respectable firms.

## ULTRA-CREPIDARIAN CRITICS.

A CONTRIBUTOR, who is nothing if not serious, and who, in his very serious moods, is not altogether free from the risk of feeling so strongly what he writes as to be a trifle careless in his manner of writing it, calls our attention to a criticism on the work of some of his colleagues who are pilloried for an "and which" and a dismembered diphthong. Conscious of human frailties, and knowing that one touch of nature makes the whole world kin, he rushes with generous impulse, but misdirected energy, to what he calls the defence of his colleagues. He cites numerous literary celebrities whose lapses from the strict rules of composition were not infrequent, and he specifies able journalists whose winged words were notoriously defective in the number or arrangement of their component letters—we had no idea that great men were so human. With growing indignation our contributor indulges in homely metaphor, and compares critics of last week's news with cooks who have to serve up last week's joint. He says that under the circumstances it is reasonable to expect they might make a hash of it; nor has he any objection to age being disguised by spices, but the picking of the dry bones of spelling or of grammar is, he thinks, neither tasteful nor nourishing. He calls that verbal criticism, for which he has little regard. He thinks nobody has any regard for it; but there, we think, he must be mistaken. In support of his own views, he sends us a quotation from Hazlitt:—

"The last sort I shall mention are *verbal critics*—mere word catchers, fellows that pick out a word in a sentence, and a sentence in a volume, and tell you it is wrong. (The title of *Ultra-crepidarian critics* has been given to a variety of this species.) These erudite persons constantly find out by anticipation that you are deficient in the smallest things—that you cannot spell certain words or join the nominative case and the verb together, because to do this is the height of their own ambition, and of course they must set you down lower than their opinion of themselves. They degrade by reducing you to their own standard of merit; for the qualifications they deny you, or the faults they object are so very insignificant, that to prove yourself possessed of the one or free from the other is to make yourself doubly ridiculous. Littleness is their element, and they give a character of meanness to whatever they touch. They creep and buzz. It is much easier to crush than to catch these troublesome insects; and when they are in your power your self-respect spares them. The race is almost extinct—one or two of them are sometimes seen crawling over the pages of the *Quarterly* [*Weekly*] *Review* [*of Reviews*]!"

"But," concludes our contributor, "I know you will think it wrong to break a butterfly upon a wheel." Of course we do. The butterfly is harmless as the summer lightning. Our contributor has no sense of humour and no idea of proportion. Besides, Hazlitt, like himself, is but a critic writing on critics, and the expression of such opinions might be continued in a very vicious circle. Our contributor's generous sentiments have misled him. There is no reflection on his colleagues. He should know that faults, whether of spelling or of taste, reflect on editors. There they rest.

**The Electric Traction Question.**

REVERTING again to this subject, as we may have to do from time to time, for there are many matters which will call for careful consideration, the Parliamentary Committee say that an uninsulated return may be used, but it shall be of such capacity and so constructed that it shall not occasion annoyance to others using the earth. Where the bonded rail has been used as a return there has been, at times, considerable resistance set up between the wheels of the vehicle and the rails, plainly evidenced by the flashes which are visible as these vehicles pass along their route. It is clear that a good contact cannot be secured at all points between the rails and the wheels; dust and dirt will accumulate; other vehicles passing over the tram rails will deposit it. If the wheels become disconnected the potential must rise at other points, and if only one wheel makes good contact it is equally clear that the limited section of the connection between the rails is not—being only one-half that of the main wire—calculated to carry it so efficiently as is desired. Great improvements are undoubtedly possible—a well jointed rail, and a brush to clear the rail in advance of the car, and further, a contact brush in addition to the wheel contact, should effect a considerable alteration in this respect. Where electric traction has progressed it has done so under the overhead system. It will be interesting to see how far English opposition to the overhead system will retard the progress of traction in this country. For this opposition, however unreasonable it may be, is real, and one which traction advocates will be called upon to combat. With regard to other interests affected by electric traction, a good deal depends upon the regulations which the Board of Trade may formulate. It is likely enough that the question will again have to be gone through, for although it may be said to have been disposed of so far as the telephone interest is concerned, there are yet regulations to be determined in relation to water and gas pipes, and for the protection of railway traffic. The latter is a question of importance to all, and it is one in which the Board of Trade is deeply interested, for whatever course that department may decide upon, the responsibility will rest with it. We do not doubt that the question will receive that consideration at the hands of the Board which it merits, and that the railway companies themselves will not neglect to see they are secured so far as to render their block system perfectly reliable. It is not well to seek to overstate a case, and an impression prevails that in one instance the railways did seek to do so. This should not, however, prejudice their claim to that just and complete consideration to which they, as caterers for the travelling public and responsible for their safety, are entitled. Their case was, otherwise, very fairly represented. When we read of a company having in operation throughout the day, and every day of the year, some 4,000 block signalling instruments, employed in regulating railway trains, most of which are laden with a human freight, we can realise to some extent the importance of the duty. We give full credence to the statement voluntarily made by Mr. Langdon, one of the railway witnesses, that railway companies have no desire to impede electric traction; all they desire is to protect their own traffic so that no element of danger may be introduced.

## ELECTRICAL ENGINEERING AT THE WORLD'S FAIR.

[FROM OUR SPECIAL COMMISSIONER.]

### I.

A FIRST glance round impresses one, first, with the magnitude of the scheme, and then with a feeling that the result does not come up to the anticipations of the projectors. The electricity building is a splendid edifice, with accommodation for at least ten times the number of exhibits in it at this date (July 1st). The spaces allotted to the largest manufacturers are not by any means fully occupied. Under the huge dome in the centre of the building the exhibits of the Westinghouse and General Electric Company occupy about the whole space with only a few exhibits. The General Electric Company (Edison and Thomson-Houston combined) are to be found all over the place, and in every class of electrical machinery. Their exhibits are most interesting, and, as a rule, their space is better occupied than any of the others. The electric welding exhibits of this company are very complete, and will be described later on.

The smaller exhibitors have interesting exhibits of specialities; these occupy the galleries, and here, again, the empty space is painfully apparent.

Some of the exhibitors are only now getting their spaces into order, so that the electricity exhibition is not yet quite complete.

In dynamo-electric machines we have many exhibits, and many of each of the leading dynamos are used for lighting the buildings and grounds.

Historically, there is considerable interest in the exhibits of Hanson and Van Winkle, who show the original magneto dynamo by Woolrich, of Birmingham. By-the-way, it may be noticed that this machine has two circuits in the armature, and generates two alternating currents in quadrature phase difference; each current is rectified by a separate commutator.

M. Gramme's original dynamo, and his first A Gramme machine, are shown in a very modest stand, in which is also a very fine bust of the illustrous father of modern dynamos —Gramme himself. It is stated that over 12,000 A Gramme dynamos had been sold prior to 1886. Siemens & Halske exhibit original dynamos and magnetos, machines familiar to every electrical engineer, and illustrated in every text-book. Siemens original shuttle-wound machine, the unipolar dynamo, and that curious dynamo in which neither field nor armature coils revolve, and the original Siemens electric locomotive, are here, but not yet arranged in place.

Coming to American historical machines, we find the Wallace-Farmer machines. These are worth describing, and shall be referred to again. Edison's first dynamo is shown also, but from a scientific point of view, it cannot compare with the dynamos of Gramme and Siemens made years before it. Even at the date of the construction of Edison's first dynamo, as here shown, the great length of the magnet limbs was well known to be bad design. One of the old direct coupled engines and dynamos is shown, also of Edison's design, and a placard states that six others are to be seen in Milan, and goes on to explain that this machine was sent to Paris Exhibition in 1880, where it is said to have astonished the *savants*. It was hardly necessary to speak of the astonishment of the *savants*; it is still astonishing to account for this most absurdly designed dynamo coming from any maker of dynamos in 1880. This type of dynamo is better known, in England, as Edison's Jumbo. It has two huge pole-pieces, embracing a large Siemens armature; the upper pole-piece is attached to eight separate magnets, and the lower pole-piece to four separate magnets, so that the magnetic circuit is only half sectional area on one side, and the magnetic flux is throttled far below half the value it might have had with the same quantity of materials, iron and copper, if properly designed. The dynamo now made by the Edison people, and here very largely in use, is the dynamo as improved by Dr. John Hopkinson, of London, an inverted horseshoe dynamo, with a heavy short magnetic circuit.

The single bobbin dynamo is largely favoured by many makers in America. It is made by the Fort Wayne Electric Company, and by the Jenney Electric Company, for lighting purposes, and by the Hanson & Winkle Company for electroplating and electrolysis.

For large outputs the multipolar dynamos are the most common. Two very large multipolar machines are used for the intramural electric railway. These dynamos are very similar to the large dynamos made in Britain and on the continent of Europe, but which are of very little interest at this date; in fact, in the continuous current dynamos, shown at this Exhibition, there is nothing new to describe. The Brush Company make an incandescent dynamo on the lines of their well-known arc dynamos. To the eye of an English electrician it has a very odd appearance, and must be of comparatively high speed and large size for a given output. The Thomson-Houston incandescent dynamo, made on the lines of their arc dynamo, is also exhibited. These machines are very possibly exhibited only as curiosities.

A class of dynamo exhibited by nearly every maker is one in which, besides the ordinary commutator and brushes, there are also three or four plain collecting rings for the purpose of obtaining alternating currents and multiphase currents from a common continuous-current dynamo. We shall refer to some of these in greater detail later on.

As a rule the American dynamos now made are of good workmanship and well designed, yet here and there the tendency to ignore the laws of the magnetic circuit is painfully apparent.

One feature observable, and on the whole a commendable one, is the large clearance allowed between the armature and the polar surfaces; in some cases a full ½ inch is allowed.

In alternating dynamos the Westinghouse Company stand away ahead of all others, and some features in their large machines are worth describing in a later article. These machines are quite a feature in the Machinery Hall. American alternators are all pretty much on the same lines of design, and as a rule, are driven at much higher speeds than British dynamos.

Motors, continuous and alternating, are of course very largely used in this Exhibition, and are exhibited everywhere. The alternating motors are multiphase motors, with the exception of a few toy motors driving small fans, and Elihu Thomson's single-phase motors. Reversed alternators are also used as motors.

We propose to describe the most interesting dynamos and motors shown, with reference to their features of novelty or good design. Only American dynamos are used for the power and light in the Exhibition, but a few foreign machines are exhibited; Gramme, Siemens, Schuckert, and Desrozier, of Paris, show their latest types of dynamos, and a large Siemens-Willans coupled dynamo and engine is being set up to run in the Machinery Hall.

The Hornsby oil engine is shown running a Holmes dynamo. This oil engine seems to be perfection in running, being combination is much admired.

The General Electric Company, of Queen Victoria Street, London, next to the Post Office exhibit from Britain, have a very good show of their specialities, and show also a combined Chandler high-speed engine and dynamo.

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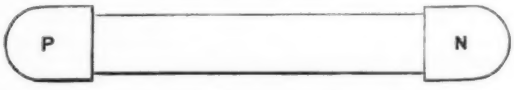
### ELECTRIC QUACKERY AT THE WORLD'S FAIR.

In the most prominent position in the gallery of the electricity buildings are to be found large spaces let off to quacks selling the most ridiculous appliances to cure everything. A large space is occupied by one of these gentry; one half is divided off and furnished most gorgeously with gold-gilt chairs in the finest of upholstery, couches and sofas to match. These are the thermo-electric chairs and sofas. The heat of the body is said to generate a mild current in pieces of metal in the stuffing of the furniture, and these mild currents circulate in the body and effect a cure, and so on. In the other half of this stand electric belts are being manufactured—so the attendant states—but all that can be seen of the process is a wire-covering machine covering the copper wire for the connections, and a stamping press stamping out the metal plates intended to be attached to the belts.

The electric belt business is an old fake, as the Americans say, but the thermo-electric chairs and sofas with them is quite a new departure in electric quackery.

Right opposite is another large space occupied by another quack, about whom a paragraph appeared in the New York

*Electrical Engineer* of 28th ult., under the heading of "Exit Fake No. 1." Fake No. 1 has, however, come to stay, and is doing a large business; his fake is to sell short sticks of ebonite mounted at each end with nickel-plated ferrules marked P and N, to cure headache; the P end is to be rubbed on the head, and generally, whenever the victim is convinced




that he is badly affected, the rubbing is a sure cure. Another fake just introduced here is to make the ebonite hollow, fill it with smelling salts, and fit one of the caps with a screw; it is then called an electric inhaler, and has a power of 15 volts—so says the quack. Electric brushes and belts are also sold at this stand.

Another small space is occupied by an electric light bath apparatus. An arc lamp is hung inside a small tent-like affair, the victim gets inside, naked, and is fitted with goggles to prevent injury to his eyes. The arc light is then made to shine upon him; by means of slides he can have any rays of the spectrum concentrated upon his skin, just as he prefers, and be half roasted at the same time. This is a bold idea, and not so bad as the others, as the purchaser is offered fair value. The arc lamp is a good lamp, and the rest of this fake is a pretty fair piece of furniture.

Further along the gallery, but not in such prominent positions, are some fine exhibits of *bonâ fide* electrical apparatus for medical purposes, some novelties in which we shall describe.

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## II.

The Westinghouse Company's exhibits are divided into three or four different spaces; perhaps the most interesting is that containing the Tesla motors and other polyphase apparatus.

One of the Tesla motors is made for an output of 500 H.P. The inductors are embedded in holes, and are about 2 inches in diameter, coupled by massive castings; this is the largest polyphase machine in the Exhibition. Smaller ones of the same type are shown, and one of these is shown running by a single-phase current; of course, it does not start with a single-phase current, but can be started by spinning it round by hand until the speed is up to about one-fourth of that equal to synchronism. If, then, the single-phase current be switched on, it gradually gains in speed until it runs synchronously. It seems that any two-phase motor can be made to run with a single-phase current when once a certain speed has been attained; that being so, there is every likelihood that single-phase commutatorless motors will be the next development for starting these motors; several devices are already proposed by Mr. Brown, formerly of the Oerlikon Works, and by Prof. Elihu Thomson, of whose motors we shall speak again.

The Westinghouse composite dynamo machine is very similar to the Schückert dynamic transformer shown at Frankfort. It can give continuous current and alternating current either simultaneously or separately; it can be used as an alternator or a continuous current dynamo; it can be used as an alternating motor either polyphase, single-phase, or as a reversed synchronising motor. It is self-exciting. A machine to do all this is simply an ordinary continuous current dynamo, to the armature coils of which three or four connections are made at equal distances apart, and connected to three or four rings on the shaft, against which collecting brushes make contact for the purpose of taking off or connecting on the alternating currents.

Very large dynamos are made with these alternating connections, the largest being those shown by the Westinghouse Company. They are intended for long distance transmission of power, specially for railway work, where the current can be transmitted over long distances by the alternating two-phase currents, and converted into continuous currents of 400 to 500 volts by these machines acting as motor generators.

It would be interesting to know who first originated this simple plan for obtaining alternating currents from continuous current dynamos. It seems, from the number of exhibitors here who make use of it, that the invention is common property.

The large alternators of the Westinghouse Company have already been described and illustrated in this Journal; the only novelty in them now worthy of attention is the method of compounding them, so that they give a constant E.M.F. In the small machines, the wires coming out from the armature coils to the collecting rings (two in number) are wound round the laminated iron spokes of the armature, as at *a*, *a*, in fig. 1. Another winding is then wound over these coils, forming a secondary, and the secondary currents generated therein are nearly proportional to the consumer's current passing from the armature. These secondary currents are rectified by a commutator, and passed round field coils wound over the constant exciting coils. This method is very similar to that patented by Zipernowski and Blathy, only they use a transformer outside of the dynamo, and require, therefore, an extra pair of collecting rings. In this Westinghouse plan the spokes and coils on them form the transformer, and rotating with the armature, require no additional collecting rings.

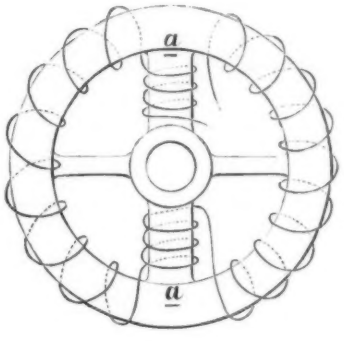



FIG. 1.

In the very large dynamos the armature spokes are strong castings, so that they cannot be used for the compounding transformer. In this case the compounding is made by two transformers, fixed in recesses cast in the wheel, carrying the armature. By using this method of compounding, very little hand regulation is required.

In the Westinghouse exhibits of polyphase currents, nothing new is shown, two-phase generators and two-phase Tesla motors forming the whole exhibit.

Schallenberger meters, Stanley transformers, switches and fuses, volt and ammeters, are exhibited at another stand; but no few feature is observable in any of these.

In the Westinghouse electric railway exhibits the large generators are multipolar, having six inwardly projecting poles. The cores of these poles are formed of stampings, so that they are laminated in a direction to prevent eddy currents arising from the movements of the toothed or Paccinotti armature. The Westinghouse dynamos are all alone in this respect; even in their alternators the field magnet poles are laminated.

The electric locomotives of the Westinghouse Company are four-pole machines "ironclad." They have no specially novel features, but are excellently made and designed machines.

In incandescent lamps, the Westinghouse Company show their famous stopper lamps. The carbon is carried on two steel wires; no platinum is used. These wires are passed through a hard fibre stopper, which has a lead air cheek packing ring, which fits into the ground tapered neck of the bulb; the lead ring, by the pressure of the atmosphere, is forced into perfect contact with the glass, and makes a perfect seal.

In arc lamps the Westinghouse Company show their flat carbon lamps, a device whereby a long run is obtained with one pair of carbons. This is, however, an old device, and was used formerly by Schückert in Pilsen lamps, and by Wallace Farmer in 1879. The Brush Company in America claim the double carbon lamp, and have obtained no less than 15 injunctions against others using double carbon lamps;

hence very few makers send out double lamps, and devices such as the flat carbons are resorted to for long runs.

The Westinghouse Company have just introduced a new alternating lamp, which shall be described later on, as details are not yet ready for the public.

Some high pressure experiments are exhibited, heavy discharges made across sheet glass and sheet ebonite. These do not seem to have any definite end in view, further than astonishing the crowd.

So far as can be gathered from these exhibits of the Westinghouse Company, there is no attempt, even, at a single phase alternating motor, self-starting, with or without load.

## MODERN GAS AND OIL ENGINES.

### IV.

IN his fourth paper, appearing in *Cassier's Magazine* for June, Mr. Spies refers to the English development of the independent gas producer for power purposes, such as the Dowson, putting down the cost of producer gas as about equivalent to coal gas at twenty pence per thousand feet, including all expenses and allowing for the greater volume of producer gas required. Considering how high is the price of gas in America, it is a little surprising to learn how little has been done there in this way as compared with England, where coal gas can be purchased in places for very little more than twenty pence per 1,000 feet. He describes the "safety vapour" engine made by the company of that name in New York: As usual, we might almost say, this engine works on the Otto cycle, but it has a peculiar valve consisting simply of a flat circular plate with a single port cut right through it, and revolving once for two revolutions of the engine, the single port communicating as it revolves with the various air and gas inlets and exhaust ports on the cover plate under which the valve revolves. The engine is regulated by varying the gas admission valve that lets gas into a mixing chamber from which it passes to the valve chest. Ignition is by electric spark passing between two electrodes in the extreme upper end of the cylinder, contact being made by special strips on the valve chest cover being brought together at each revolution of the valve. The valve is driven by a link belt from the crank shaft. This engine is adapted to the use of gasoline as well as gas.

In the Rollason engine, the English builders of which are Messrs. Wells Brothers, of Sandiacre, the original mode of working was that known as the three-cycle, whereby between two explosive strokes there is both an exhaust and a scavenging charge. Three revolutions thus form a cycle and every sixth stroke only is explosive. This, however, has been abandoned for the ordinary four stroke. The author lays stress on the advantage of the scavenger charge in securing rapidity of combustion, and the present writer is inclined to agree with this, and so probably will most engineers who have had opportunity of noting the gradually softening exhaust in engines which run several explosive revolutions with an interval of several non-explosive revolutions, during which the cylinder is purging itself of burnt gases.

The scavenger charge is still retained in the four-stroke Rollason engine, but is now secured by means of an air-compressing piston attached to the front of the main piston. This slightly compresses the scavenger charge and, near the completion of the exhaust stroke of the main piston, a valve admits the scavenger charge to the cylinder, which it sweeps out, *via* the exhaust port kept open to facilitate this action, until the crank has passed the centre, after which the fresh charge is admitted. Regulation is partially effected by varying the amount of the gas charge, but there is also the customary hit and miss device which is so aggravating a feature in gas engines to most engineers who look for regularity in turning as the chief virtue of a prime mover.

All the valves are of Poppet type, the slide valve, so unsuitable for gas engines, being wisely abandoned and the tube igniter also is employed—not the compression tube but a tube containing a flame which ignites the charge through the medium of a somewhat complicated arrangement of ports, passages, and valves.

There is a hand pump for starting the larger sizes, and for the smaller sizes the compression tube igniter is considered sufficient, without the special ignition valve.

The Capitaine oil engine illustrates what the Germans are doing in the direction of petroleum engines. Working on the familiar Otto cycle there is an oil vaporiser heated by a lamp which is also fed by vapour generated by its own heat. The ignition tube is heated by the same flame also, but in later engines the charge is fired by the vaporiser alone.

Oil is forced up to the vaporiser by a pump worked by the same eccentric that operates the exhaust valve, gear being provided so that the eccentric only operates these during one revolution and misses during the next.

When fitted in a launch the oil pump is made to lift from a tank placed below. Supply is regulated by a fly-wheel governor through the agency of a sleeve on the crankshaft and suitable connections. It was a Capitaine engine which, tested at Chester last year, gave a speed of 8½ knots with 6½ H.P., the weight of engine being 2,000 pounds.

The "Trusty" petroleum engine of Weyman and Hitchcock, of Guildford, Surrey, is made both single and double cylinder, in the latter case the cranks being both in one direction, but the Otto cycle being used, the two cylinders are out of step and an explosion is thus secured every revolution if wanted. There is an oil pump, a vaporiser, and a tube igniter.

In the Brayton engine there is no vaporiser, but merely an atomiser, the oil being divided into sufficiently small particles to burn, in the air which atomises it, with explosive rapidity. The oil is only admitted when the "explosion is wanted, so there is no question of timing the ignition or securing a proper or sufficient degree of compression. This is secured by an adaptation of that familiar lecture room experiment showing invisible or rather flameless combustion, the jet of atomised oil as it enters the cylinder making contact with a coil of platinum, which, once made hot is kept so, as long as the engine works, by a jet of hydro-carbonised air kept constantly impinging on it. Of course the explosive charge can only be forced in by means of air at a higher pressure than that of compression in the cylinder, and this is secured by a pump which compresses to 80 lbs., and is worked from the beam of the engine, the Brayton embodying this somewhat antique, but exceedingly convenient, detail. Part of the air is made to escape continuously to the cylinder through a narrow pipe and to carry oil up with it. The end of the pipe is closed by a pad of asbestos and projects into the cylinder, the heat of which vaporises the oil thus conveyed into this fibrous retort, from which it issues through a gauze upon the platinum coils to be maintained incandescent, and this coil is close to the sprayer, through which enters the atomising stream of oil laden air to yield the explosive charge. To regulate the amount of oil forced up for explosion there is a wedge piece interposed between the end of the eccentric rod and the oil plunger; by a to and fro movement, of this wedge by the governor the stroke of the oil plunger may be varied up to its maximum, which, of course, is equal to the full throw of the eccentric. The platinium coil requires to be heated by a torch introduced through a door provided for the purpose. Air is admitted through the piston under the explosive charge, and so in a position to sweep out the residuals when exhaust takes place. There is also a scavenging action in this engine. The Otto cycle is worked, with of course the modification that the compression charge is of air only, and the exhaust valve is kept open for the first part of the compression stroke, in order to somewhat scavenge the cylinder.

## THE ELECTRICAL WORKS AT SZATMAR.

[FROM OUR OWN CORRESPONDENT.]

SZATMAR is the third provincial city of Hungary which possesses electrical works for the supply of current for public and private lighting, and the first Hungarian city which has executed electrical works for its entire illumination with a continuous current and accumulators.

The works are at a distance of 800 metres from the centre of the town, and on the bank of the river. The accumula-

tors have been placed in the buildings of the theatre, in the middle of the town. The distribution of current is effected from these accumulators.

At the central station there are two safety tubular boilers, each of 56 square metres of heating surface; two engines, each of 50 effective H.P., with condensers. Each steam engine drives a Siemens dynamo of the type H 2 O. Space is left for the erection of a third boiler as a reserve.

The engines have 275 mm. cylindrical diameter, and 550 mm. stroke, and make 125 revolutions per minute.

The two steam engines have a common pipe for the admission of steam, which allows water to escape automatically at three places. The feed and condensing water is taken from the river by means of a steam pump, and drawn into a cistern of masonry. The condensing water required for the air pump is drawn from this cistern. The hot water of the condensers is led into a hot-water tank, and escapes into the river.

The injectors and the feed-water pumps obtain the requisite feed-water from this tank.

The two continuous current dynamos, at an average speed of 630 revolutions per minute, yield 100 ampères at 250 volts.

The tension of the current can be raised to 350 volts for the purpose of feeding the accumulators.

This increase of tension is effected by a corresponding change of the magnetising current by means of rheostats, so that it is not necessary to increase the number of revolutions of the dynamos in order to heighten the tension. If necessary, the dynamos may work parallel with the accumulators. For this purpose each dynamo is provided with a handswitch and an automatic switch.

The latter serve to prevent the current of the accumulators from flowing back into the dynamo.

The current produced at the central station is led for a distance of 800 metres to a battery of accumulators, where the switchboards are placed. The loss of current is about 12 per cent. The switchboard is exactly above the accumulators.

The battery of accumulators consists of two groups of 63 elements each, of the Tudor type XII. for 480 ampères.

The two groups of accumulators are arranged one behind the other, and when at work they are arranged parallel with the dynamos. The efficiency of the installation is thus increased to 272 ampères at a tension of 200 volts.

The maximum charging current is 92 ampères, and the charging is completed when a uniform evolution of gas takes place simultaneously at a tension of 162 volts.

The discharge ensues with a current of 72 ampères, and can only be continued until the tension falls to 108 volts.

The distributive net proceeding from the switch room is arranged on the three-wire system, and the conveyance of currents for lighting the theatre, the public streets, and that for private consumers, are effected each by a separate main.

In the theatre there are at present 174 glow lamps at 10, 24 at 16, and 32 at 25 normal candles, as also 1 arc lamp. The working tension is 110 volts.

The cable for supplying private consumers is conveyed underground as far as the Deak Place, where it joins a circular main from which the feeding mains branch off to the several private houses.

The mains for private lighting are of such a size that 500 glow lamps at 16 normal candles may be fed simultaneously. The working tension amounts to 100 volts, and the loss of conduction to 7 per cent.

All the mains, except those underground for private houses, are carried overhead, and are of bare copper, supported on porcelain insulators.

For private lighting, exclusive of the lamps in the theatre, there are 8 at 5, 34 at 8, 14 at 10, 650 at 16, 76 at 25, and 12 at 50 normal candles, as also three arc lamps at 6 ampères.

Small consumers pay gross amounts agreed on in each case. For larger consumers electricity meters are set up, and the current is charged at 4 kreutzers per ampère-hour.

The public lighting consists at present of 335 glow lamps at 16 normal candles, and 12 arc lamps at 6 ampères.

The installation has been at work since last year, and, so far, gives full satisfaction.

## A ONE-VOLT STANDARD CELL.

THE calomel cell consisting of mercury in contact with mercurous chloride and zinc in a solution of zinc chloride was first described by von Helmholtz in 1882.* Without any knowledge of its previous invention the same cell was made by Henry S. Carhart six years ago, and he has still preserved the first sample. Ostwald† refers to a calomel cell giving 1 volt E.M.F. at 15° C., the density of the zinc chloride being 1·409 at 15°, and the temperature coefficient + 0·00007 volt per degree. Within the last few months Carhart has taken up the calomel cell again with a view of adjusting it to precisely 1 volt, making a careful determination of its temperature coefficient and investigating its reliability.

It is now well known that the E.M.F. of a voltaic cell with zinc immersed in a solution of one of its salts decreases with increase of density of the solution.‡ Within limits, therefore, the E.M.F. of a cell can be varied by changing the density of the solution of the zinc salt. Thus the E.M.F. of a Clark cell was found to vary from 1·434 volts with a solution saturated at 20° C. to 1·481 volts with a 5 per cent. solution—a variation of nearly 3½ per cent. The variation of the E.M.F. with density is even greater in the case of zinc chloride; with this substance 16 per cent. increase of density produces 3·5 per cent. decrease in E.M.F. An equal increase of density of zinc sulphate is accompanied by only half the percentage decrease of E.M.F.; hence greater care is necessary in standardising a solution of zinc chloride than of zinc sulphate.

Taking the Clark cell with excess of crystals of zinc sulphate as the standard, and having an E.M.F. of 1·434 volts,§ Carhart has found that the density of the zinc chloride solution required to give 1 volt is 1·391 at 15° C. Ostwald's density gives too low a value; it was probably adjusted to correspond with the legal ohm.

The 1-volt cell is made in the same form as the Clark standard. In the bottom of the tube is pure mercury in contact with platinum wire. On this a paste of mercurous chloride and the zinc chloride solution is placed; a cork diaphragm follows, holding the mercury and paste firmly in position (especially with some asbestos packing under the cork); zinc chloride is then added to the proper depth, and an amalgamated zinc rod, supported by a cork, completes the electrical combination of parts. The cell must be hermetically sealed, as usual. Such a cell is portable and gives promise of long life. Its internal resistance is about 1,500 ohms, and it does not appear to suffer permanent change by heating to 50° C., or even to 60°. The cell, six years old, already mentioned, is still in good condition, and has apparently maintained its E.M.F.

An interesting feature of the 1-volt cell is its small positive temperature coefficient. The coefficient of the Clark and the Daniell standard is negative; but the calomel cell has a coefficient of about + 0·00009 within working limits of temperature. Carhart has recently‖ made a number of observations on the temperature coefficient, with the result, *inter alia*, that the well-known law of temperature coefficients is confirmed and Bouty's statements¶ shown to be in error.

## PARSONS'S STEAM TURBINE DYNAMO AND ALTERNATOR.

PROF. KENNEDY has been making a series of trials with one of Mr. Parsons's turbo-motors driving a continuous current dynamo, having an output of 150 units. We extract the following from the report made by Prof. Kennedy.

"The machine tested was in external dimensions almost exactly the same as that tested in August last by Prof. Ewing, but by a rearrangement of the plates and discs its output had been very considerably increased. Its nominal maximum capacity was 150 units when working with 120 lbs. steam pressure, but it gave this output without

* *Sitzber. der Akad. der Wiss.*, p. 26, Berlin, 1882.
† *Zeitschrift für Physikalische Chemie*, Vol. i., p. 403.
‡ *Amer. Journ. Science*, November, 1884, p. 374.
§ *Report of the B.A. Committee*, Edinburgh Meeting, 1892.
‖ *Amer. Journ. Science*, Vol. xlvi. (Series 3), pp. 60—66.
¶ *Journal de Physique*, Vol. ix., p. 229.

apparent difficulty at 100 lbs. steam pressure, as will be seen below.

"The particular machine tested by Prof. Kennedy had six high pressure single discs, and one low pressure double disc, the two sides of the latter being in parallel. It ran at about 4,500 revolutions per minute.

"The tests made were essentially directed to the determination of the quantity of steam used per electrical horse-power hour by the motor at different loads. The water measurement was carried out by means of a little tank holding 370 lbs. of water (as checked by direct weighing). From this tank water was allowed to run into a somewhat larger one below it, from which the feed pump drew its supply. The feed pump itself was worked by steam from a second boiler, which also supplied steam for the air-pumping engine. The boiler used for supplying steam to the motor was a small boiler of the locomotive type, capable of running only at 100 lbs. pressure. The boiler was so small for its work that there was no difficulty in keeping the feed practically continuous throughout the trials, and in keeping the water-level very steady. When running at full power the feed measuring tank lasted only 8 minutes, so that it was easy to get a large number of points upon the water line in the diagram.

"The steam from the boiler passed through a series of superheating tubes on its way to the engine, these tubes being surrounded by the waste gases passing from the boiler to the chimney. In all the trials made, except where the engine was running light, there was a very considerable amount of superheating attained in this manner. It is to be regretted that it had not been found possible beforehand to make the boiler and its connections perfectly steam tight. There were a not inconsiderable number of small leaks taking place, the total amount of which may quite well have considerably impaired the apparent economy of the motor. It was impossible for Prof. Kennedy to take these leaks, such as they were, in any way into account, and the water consumption which is given therefore includes the whole of them, whatever they may have been.

"The dynamo which was used in the experiments had a continuous current armature, not intended to take more than about 120 units. This was the largest power for which the boiler could supply steam for more than a very short time, and this fact limited the maximum power at which any water measurements could be made. The whole of the electrical measurements were made by zero methods, using a Crompton potentiometer and standard Clark cells. A standard platinoid resistance of ·001 ohm, which was sensibly free from temperature error for very much larger currents than those which were used, was employed in connection with the current measurements. The work done by the motor was taken up upon an artificial resistance of spiral wire divided into sections to suit the different powers required.

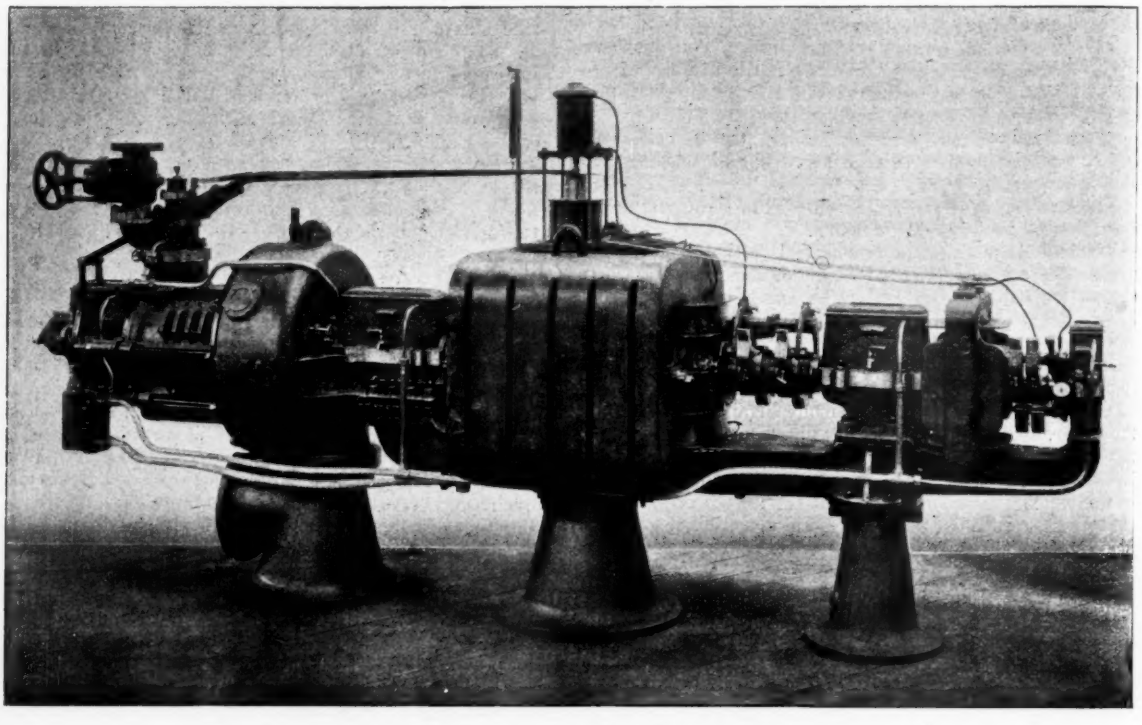
"During each trial the steam pressure and water level were noted each time the measuring tank was emptied. The temperature of the steam, the vacuum, and the speed of the engine were noted at the same time or more often. The electrical measurements were made at regular intervals of five or 10 minutes, according to the duration of the trial."

A summary of the trials will be found in a subjoined table.

"Experiment E, at about 110 kilowatts, is the one which Prof. Kennedy looked upon as the most important, as it was run at the largest power for which the steam could be kept up for any length of time. The actual duration of the run was just over two hours, in which time 17 tanks of water were used. Both the power and the water were very uniform during the whole of the run, and having obtained so many points on what appeared to be a straight line, it did not appear worth while to prolong the trial further. In this trial the mean output was at the rate of 110·8 kilowatts, or 148·5 E.H.P.

"The boiler pressure was 94·5 lbs. above the atmosphere, and the average amount of superheating was 66·7° Fahr. The average vacuum shown by the gauge was 13·95 lbs. per square inch, the pressure of the atmosphere being equivalent to 30·3 inches of mercury, or say to 14·86 lbs. per square inch. The total water used per hour was 3,094 lbs., which is equivalent to 27·9 lbs. per kilowatt-hour, or 20·8 lbs. per E.H.P. hour.

"In the two trials A and B (which were made on two different days), when the motor was running empty, circumstances rendered it only possible to use one tank full of water each time. There are, therefore, in these cases no such checks afforded as in the other tests by the straightness of the water-line throughout the whole duration of the trial. The two tests, however, agree with each other very well, and



PARSONS'S STEAM TURBINE-ALTERNATOR COMBINATION.

the two corresponding points, lie very nearly in their proper place at the commencement of the line which represents the total water used per hour.

"The amount of superheating appeared to depend to a considerable extent, as was natural, upon the work which was being done by the boiler—that is to say, upon the amount and temperature of the chimney gases. Running empty, there was no superheating, or, rather, the superheating had fallen to nothing by the time the steam reached the engine, close to which its temperature was measured. There may have been, even then, a very considerable amount of superheating given to the steam after it had left the boiler. In trial C, which was really made immediately after trial D, the superheating commenced at the point at which it had reached during D, but after half-an-hour it fell to a much lower point, and remained there steadily. In trials D and E the amount of superheating rose from the beginning until it attained what appeared to be a more or less normal amount for the corresponding power. In trial F the temperature was still rising, when other causes compelled Prof. Kennedy to stop the experiment. After all the other trials were ended, Prof. Kennedy had the motor run up to give an output of 150 kilowatts, in order simply to see whether it could actually deal with this load. It was impossible to keep up steam for more than a few minutes under these conditions, and therefore no water measurement could be made, but it was found that with a steam pressure falling from 100 lbs. down to 90 lbs., the motor could drive the armature with an output of 152·6 kilowatts, apparently without the slightest trouble. The vacuum at this time was 13·8 lbs. per square inch, and the steam temperature had only had time to reach 380° Fahr. when the machine was shut down. The motor was running about 4,600 revolutions per minute, as will be seen from the table.

"The following table gives the principal figures, totals and means, &c., connected with the seven trial runs :—

| | A | B | C | D | E | F | G |
|---|---|---|---|---|---|---|---|
| Duration of trial, in mins. | 35·5 | 34·0 | 72·0 | 93·0 | 122·0 | 46·5 | 7·0 |
| Mean boiler pressure, lbs. per square inch ... | 95·8 | 98·5 | 97·0 | 94·6 | 94·5 | 97·1 | 97·0 |
| Corresponding mean temperature, degrees Fah. | 335·2 | 337 | 336 | 334·4 | 334·3 | 336·1 | 336 |
| Actual mean steam temperature close to engine, degrees Fah. ... ... | 330·3 | 331·3 | 356 | 371 | 401 | 391 | 380 |
| Amount of superheating | ... | ... | 20·0 | 36·6 | 66·7 | 54·9 | 44 |
| Mean vacuum, lbs. per sq. inch ... ... ... | 14·3 | 14·1 | 14·28 | 14·28 | 13·95 | 14·11 | 13·8 |
| Mean injection temperature, degrees Fah. ... | 50 | 63·3 | 64·4 | 58·6 | 70·7 | 61·7 | ... |
| Mean hot-well temperature, degrees Fah. ... | 62·6 | 68·9 | 72·9 | 75·2 | 89·8 | 80·6 | ... |
| Mean revolutions per min. | 4,268 | 4,385 | 4,480 | 4,475 | 4,655 | 4,625 | 4,592 |
| „ current, ampères ... | ... | ... | 105·5 | 260·3 | 420·7 | 482·5 | 576·5 |
| „ E.M.F., volts ... | 265·1 | 267·2 | 264·9 | 264·3 | 263·3 | 254·9 | 264·7 |
| „ kilowatts ... ... | ... | ... | 27·94 | 68·8 | 110·8 | 123·0 | 152·6 |
| „ E.H.P. ... ... | ... | ... | 37·45 | 92·21 | 148·5 | 164·9 | 204·6 |
| Total water used, lbs. ... | 370 | 370 | 1,480 | 3,330 | 6,290 | 2,590 | ... |
| „ „ per hour, lbs. | 625 | 653 | 1,233 | 2,148 | 3,094 | 3,342 | ... |
| Water per kilowatt-hour, lbs. ... ... ... | ... | ... | 44·1 | 31·2 | 27·9 | 27·2 | ... |
| Water per E.H.P. hour, lbs. ... ... ... | ... | ... | 32·9 | 23·3 | 20·8 | 20·3 | ... |

"It is obviously not necessary for him, says Prof. Kennedy, to point out that the figures given in this table are figures of unusual excellence in economy, for they certainly rank among the best results hitherto obtained in the direct driving of dynamos by condensing machinery. The construction of the motors allows the advantage of superheating to be carried to the fullest extent, without any chance of injury to any parts of the machine, and no doubt this wise use of superheating has contributed, to no small extent, to the exceptionally good results which have been obtained.

"Since making the trials of which the results are summarised, Prof. Kennedy has been able to have special experiments made, with a view to determining to what extent the superheating has contributed to the result obtained. Their leading results may be summed up by saying that at about 35 E.H.P. the steam used without superheating was the same as with superheating, but that the difference gradually increased until at 100 E.H.P. it was about 8 per cent. The working of the boiler did not allow the non-superheating experiments to be carried farther than this, but if the same law of increase of economy held good up to the full power of the machine, its actual water consumption, as tested, must have been about 10 per cent. less than it would have been without superheating—a very notable difference. Of course this figure must be taken as only approximate, but it shows that even without superheating, the motor would show very good results.

"The engine worked throughout the trials without giving the slightest trouble in any way, either at low or at high loads. The throttle valve was full open in each case, and the engine ran upon its governor, which appeared to control it in a satisfactory manner."

## GAS ENGINE STARTER.

THE Lanchester and Clerk gas engine starter is a combination which merits the attention of our readers interested in the manufacture of gas engines. This starter is made under the combined patents of Lanchester's gas engine starter and Clerk's high-pressure impulse system.

The starter is shown in fig. 1. In this combined arrangement engines are started by the simple turning of a cock, even under full load. The high-pressure impulse is produced

FIG. 1.

by giving compression to the starting charge before its ignition, which is accomplished by the Clerk system in a novel manner, so that no initial work has to be done at all, and no compressed air reservoir or stored-up energy is employed.

That initial compression is obtained without the use of either a storage reservoir or compressing pump; this is made clear by the following detailed description :—

The starter chamber, A (fig. 2), is placed beside the engine cylinder and coupled as shown. A check valve, W, serves to prevent gases passing from the cylinder into the starter chamber. The screw clamp, Z, is provided to permanently close the valve, W, when the engine is running. Gas is

delivered to the starter chamber by a ¾ inch supply pipe, G, connecting from behind the gas bag and pressure regulator, and branching into two ½ inch pipes, J and J. Ignition is effected by the igniter, Y, the burner of which is fed by the supply pipe, L.

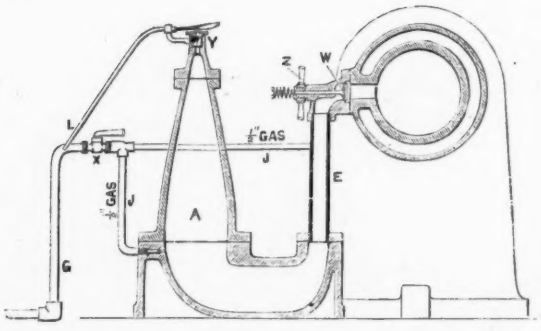



FIG. 2.

The action of the apparatus is as follows :—

The check valve is released by its clamp, Z, when stopping; the engine then, while slowing down, sucks the starter chamber free from products of combustion, air entering through the igniter nozzle, Y.

In order to start, gas is allowed to flow in through the pipes, J and J, forming mixture in the coupling pipe, E, and chamber, A, a portion of this issuing from the nozzle, Y, becomes ignited, the supply cock, X, is then turned off and ignition passes into the chamber, A. The first portions of the charge ignited expand, pushing a body of mixture past the check valve, W, into the cylinder of the engine and increasing the pressure therein; this is closely followed by the advancing flame, and thus in a fraction of a second the combustion space and cylinder of the engine have been charged with compressed mixture and ignition effected.

Immediately the flame passes the valve, W, the rise of pressure in the cylinder closes the said valve and starts the engine. The clamp, Z, is then turned to close the valve.

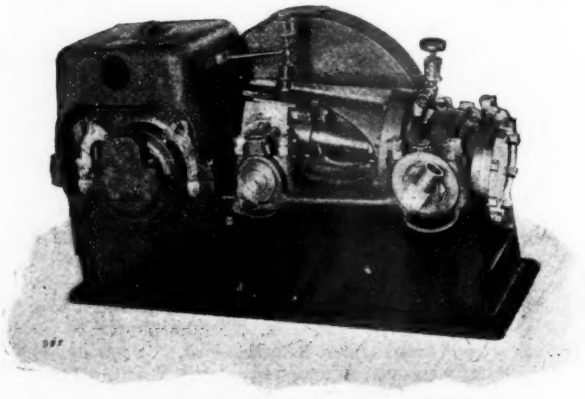
The igniter and flange fitting on pipe, E, are interchangeable, and starters can be fitted in different ways.

There is a considerable number of these starters in use at the present moment, and we are informed that they have given general satisfaction. They can be used with any cycle, and with very little modification work just as well with Dowson as with town gas.

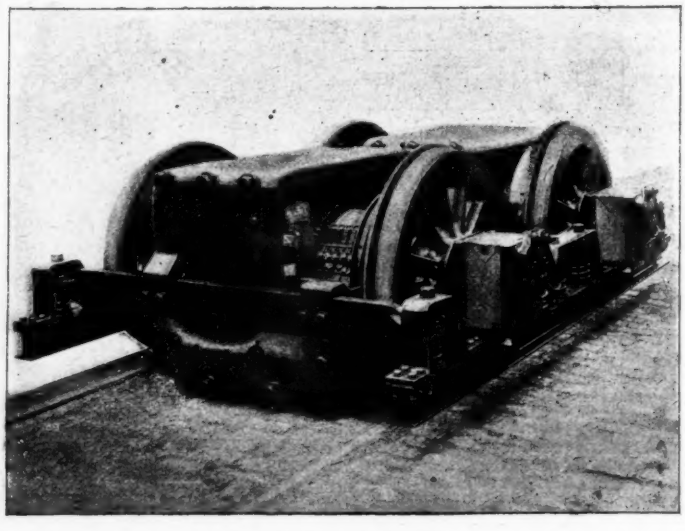
## HIGH-SPEED ELECTRIC LOCOMOTIVE.

WE are indebted to the General Electric Company, of New York, for the following description of a new locomotive made by them :—

The first electric locomotive of any considerable size in the United States, and the first practically operative high-speed electric locomotive in the world adapted to the steam railroad, has recently been completed at the Lynn Works of the General Electric Company, and will shortly be exhibited at the World's Fair. Its completion marks a distinct advance in electrical development.



VIEW OF ELECTRICAL AIR COMPRESSOR.



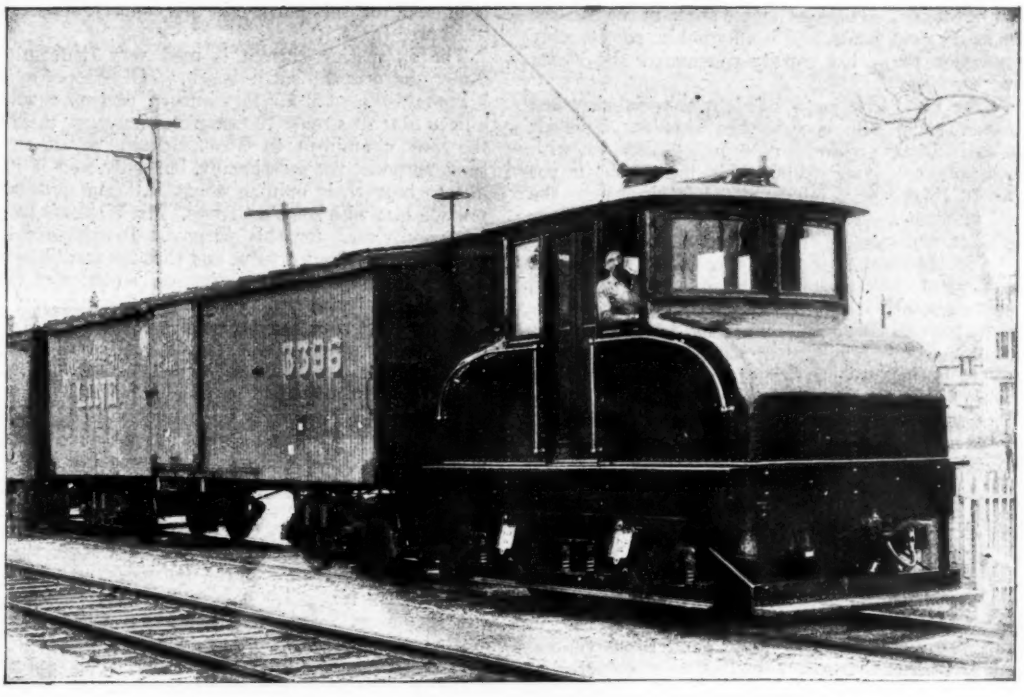
MOTOR MOUNTED ON BOGIE.

LOCOMOTIVE ON RAILS.

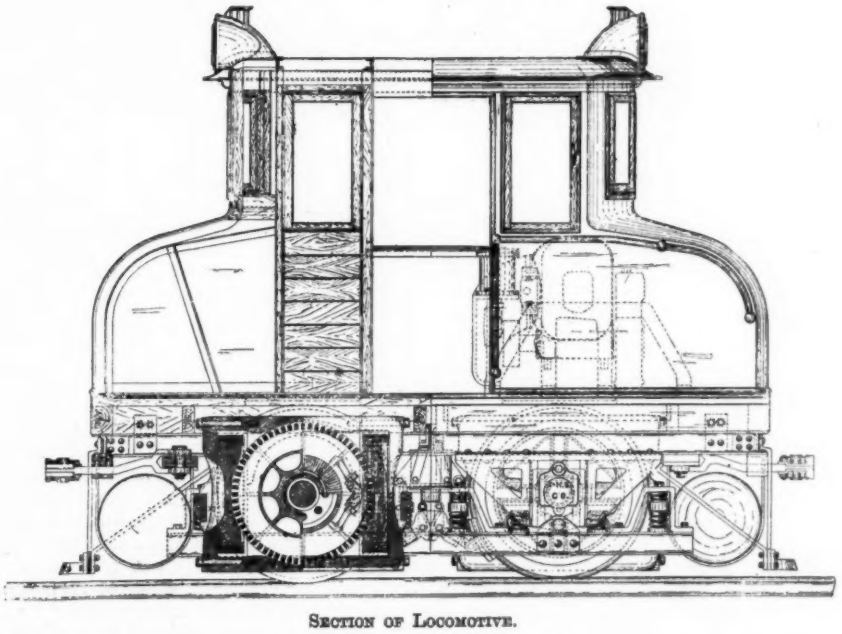
It is a 30-ton locomotive, designed for a normal speed of 30 miles an hour, primarily intended for operation on

elevated railways, and for passenger and light freight traffic on less important steam roads. It is of compact construction, solidly and substantially built, and runs on four 44-inch wheels. Its dimensions are: 16 feet 6 inches long, 11 feet 6 inches high, 8 feet 4 inches broad, having its draw bars 2 feet 6 inches from top of rail—the Manhattan Elevated Railroad standard height. The draw-bar pull is calculated at 12,000 lbs.

The motor fields consist of massive iron castings, to which the hollow field spools are bolted. The armatures are of the iron-clad type, having each separate winding embedded in a mica-lined slot cut into the curved surface of the laminated iron armature body. The axles of the locomotive pass through the hollow shafts on which the armatures are mounted. These shafts rest in bearings of the motor frame, and are connected to the axles by universal couplings, which




LOCOMOTIVE COUPLED TO TRAIN.



SECTION OF LOCOMOTIVE.

The propelling power is furnished by two electric motors of especial design and construction, each axle being provided with one motor. The motors are gearless, and are supported on spiral springs resting on the side frames of the locomotive truck. This method of suspension leaves the wheels free to adjust themselves to the irregularities of the road bed, and consequently the wear to both tracks and motors is diminished.

allow of freedom of motion in all directions. The commutators are of massive construction, and there are four sets of brushes to each commutator.

The motors are controlled by means of a series parallel controller, set up in the interior of the cab. This device embodies all the latest improvements made in this type of apparatus by the General Electric Company. Under test it is found that the series parallel controller allows of a more

gradual and easier starting of the electric motor, and the speed can be more delicately and instantaneously controlled than in the case of the steam locomotive.

The truck, suspended from the journal boxes, is constructed of heavy I beams, and forms the foundation for the locomotive cab, of sheet iron, of symmetrical design, and so curved off as to diminish the atmospheric resistance as far as possible. The interior is finished in hard wood. Two sliding doors are placed at each side of the cab, and the windows are so arranged as to permit of an unobstructed view in all directions. There is ample space in the cab for the motor man's movements, and it affords him considerably better protection than that usually vouchsafed the steam locomotive engineer.

The air for the brake is supplied by a special electrical air compressor, which also operates the whistles. This air pump has an oscillating cylinder of 6 inches diameter, with a 6-inch stroke, supplying 6,000 cubic inches of air per minute, at 70 lbs. pressure. The motor is similar to the N.W.P. 2½ in general appearance, but is wound for a higher speed. The normal speed of the armature shaft is 675 revolutions, and of the crank shaft of the pump 110 revolutions. The dimensions of the air compressor are, length 41 inches, width 16½ inches, height 25 inches. The pump motor is controlled by a special rheostat. This, by an intermediary device, is automatically regulated by the air pressure.

The use of these locomotives over very long distances is at present limited only by the cost of long lines of electric feeders, and until the problem offered by this condition is solved, restriction of its employment must necessarily exist. But for places comparatively near each other, and where traffic is dense, the denser the better, the electric locomotive is peculiarly adapted, for here all the advantages of electric propulsion are available, unhampered by the extreme expense involved in long feeder lines.

The evolution of the use of the electric locomotive will probably follow along the lines dictated by expediency and favouring conditions. At first they will probably be used in elevated railroad service, and in New York, Brooklyn and Chicago alone their advent will be hailed with a feeling of deep gratitude. They will then probably be adopted as feeders to the trunk lines, both for freight and passenger traffic; and to operate short suburban lines, where a rapid efficient service is requisite. Their peculiar fitness for switching purposes will advance their use another step, and then slowly as the different problems presented are overcome, they will invade the province of the trunk line steam locomotive, and the millennium of railroad travel will be within the realities of life.

## CORRESPONDENCE.

### Relative Safety or Danger of Electric Light Currents.

Under the above title, the Correspondence columns of the ELECTRICAL REVIEW seem to have become a happy hunting ground for some firms, desirous of advertising peculiar kind of elements, rheostats, &c. The confusion displayed by some correspondents about the real question at issue is quite astonishing.

As Mr. Shippey takes the fact that only one firm has troubled itself to reply to his letters, as a proof that all the others of your readers who are interested in this matter accept his views as correct, I should feel obliged if you would allow me a short space for a reply.

Electricity is used in two different manners for medical purposes; it can either be sent through the patient's body (faradisation, galvanisation, and electrolysis), or else it may be used for heating platinum wires or small lamps. In the latter two cases the patient's body forms no part of the circuit, and is not reached by the current.

The direct application of the alternating current supplied by dynamos is very limited; the current differs widely from that produced by a medical coil, the alternations are so exceedingly rapid (about 12,000 a minute), that the muscles have not got time to contract and relapse completely, they remain in a semi-contracted state, whereas at present most medical men prefer comparatively slow interruptions (100 to to 1,000 a minute) producing powerful contractions. Moreover, a good rheostat for regulating the current of a dynamo is more expensive than a good medical coil, and for these reasons the current required for faradisation will rarely be taken directly from a dynamo.

I agree with Mr. Shippey in not recommending the *alternating* current for *galvanic* purposes. Mr. Shippey seems to be under the impression that the alternating current is used for *electrolysis* in gynæcological operations. It has never been used for this purpose in this country, and is not likely to be used for it.

The alternating current is used very frequently to heat cautery burners and small lamps. Mr. Shippey tells us that it *cannot* be used at all for cautery; perhaps it will interest him to hear that some 100 surgeons, amongst them many of the most prominent in Great Britain, use it already for these purposes, not occasionally, but daily, and if he should like to hear their opinion about it, I am quite willing to provide him with some addresses. Mr. Woakes's transformer is generally used for this purpose. It reduces the current for cautery to about 4 volts, and that for small lamps to 5 to 12 volts. Supposing even that the insulation of the mains, or the main transformer might get defective, and that the E.M.F. might rise suddenly from 100 volts to 1,000 or more (a possibility which is very remote indeed with underground mains, which are universally used in this country), the platinum point may melt, or the lamp may burn out before the fuses act, but certainly the patient will be none the worse for it, and a safer, more reliable, more convenient, and cheaper apparatus can hardly be thought of.

As to the continuous current, I am quite at a loss to see how, with underground mains, it might happen that accumulators, which supply most districts during day time—the time during which nearly all electro-medical treatment is being carried out—or even the dynamo, might increase their E.M.F. from 100 to 1,000 or more volts; but this may be my ignorance. Mr. Shippey speaks of defective insulation, badly constructed transformers, defective fuses, &c. In short, everything defective, except those cells and apparatus in which he happens to have a personal interest, and which are, of course, the *ne plus ultra* of perfection. As great damage would be done to lamps, dynamos, &c., if ever a 100-volt current increased to 1,000 volts, we should be sure to have heard of such accidents, if they had ever happened.

A slight variation in E.M.F. does not matter; the thing to be dreaded is a sudden interruption of the current, and not a slight variation of its strength. Now, unforeseen interruptions do happen with batteries, certainly more frequently than with dynamos. Or does Mr. Shippey mean to say that the danger of the circuit being broken through corrosion of a wire, is greater in a light installation, were the wires are very well insulated and comparatively thick, than in a battery, the wires of which are poorly insulated, of small diameter, and in close proximity of acids, salammoniac, &c.? Or has it never happened to him that a zinc in an element drops suddenly off after having been eaten through by long use? With English made cells this is pretty sure to happen in due course of time; of course they may be defective, and I should not be surprised to hear that the zincs in the ideal American Law cells do last for ever.

An incandescent lamp of 8 candle-power, inserted in the circuit in series with the apparatus, and in such a manner, that it cannot possibly be cut out by any mistake on the part of the operator, is in my opinion a necessary addition to any apparatus destined to utilise dynamo currents for medical purposes. It will protect the patient from receiving a dangerous dose if the operator should by mistake put his rheostats at 0, and it will prevent the galvanometer, &c., from being destroyed in case of accidental short-circuit with the cords or electrodes.

Carelessness on the part of the manufacturer or the operator may produce serious results, but there exist no safeguards against carelessness anywhere. It is, however, my firm conviction that intelligent construction and careful use make it, at any rate in Great Britain, quite as safe to use the continuous current supplied by a dynamo as that of a large battery; the risk of shocks are smaller in the former case, and this opinion is confirmed by the report of several installations, made for that purpose, some of them in regular use since two years. Rheostats require no recharging, and it is

evident that it is more convenient and cheaper to get the electricity supplied by merely turning a switch, than to have to manufacture it oneself.

Mr. Shippey is kind enough to inform us that he does not waste his time with the study of the literature relating to electro-medical therapeutics. I thought this statement rather superfluous, for I am sure every attentive reader of his letters has got that impression.

I enclose my card, and am, yours faithfully,

C. S.

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Please allow us, in reply to Mr. Arthur Shippey, to remind him that the subject under discussion is the "Relative Safety or Danger of Electric Light Currents," and not if his apparatus be superior to ours and that of all other makers.

We have no desire to see this correspondence deteriorate into a duel between rival manufacturers, and therefore shall not write again unless light be thrown upon it from some other source.

**The Electro-Medical Apparatus Company,**
LAWRENCE & KIRK, *Managers.*

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### The Fire at the Manchester Reference Library.

We notice in this week's edition, under the heading of "Notices," reference was made to a slight fire which occurred at the Manchester Library. You might correct this in the following manner, as a number of daily journals have made the absurd statement that it was caused by the electric light. The installation has only been commenced by us during the last three weeks, and will not be completed for a month. The fire, which was only slight, and damaged a portion of the ceiling of centre dome of library, it is supposed was caused by the upsetting of a lamp, although there is no direct evidence of this. The Corporation, moreover, have exonerated us from any blame in the matter, and there is no damage done to the books whatever.

**B. Verity & Sons.**
CHARLES S. NORTHCOTE, *Electrician and Manager.*
*July 21st*, 1893.

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### The Cost of Supply at Southampton.

I am surprised to see a note in the current issue of your paper referring to the cost and quality of our supply.

Would you kindly correct this statement in your next issue.

Our cost of production during 1892 was 9·15 pence per unit sold, and during the latter half of that year it was 7·02 pence. Our selling price averaged 7·28 pence per unit in that year.

With reference to the rumour which has reached you as to the quality of the supply, I can only say that it has not reached Southampton; as we have not had a breakdown since the supply commenced, I cannot understand that part of your note.

**K. A. Scott Moncrieff,**
*Engineer to the Company.*

[We are pleased to give publicity to this authoritative statement and regret that our note was based on wrong information.—EDS. ELEC. REV.]

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### Inventor of Gutta-Percha Covered Wire.

With reference to the paragraph on page 71 of this week's issue, the enclosed copy of a letter written to our late Mr. W. Reid by the late Mr. Sam Statham may be of some interest to you and your numerous readers.

**Reid Brothers.**
*July 21st*, 1893.

P.S.—The original letter is pasted in our scrap book.

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[COPY.]

Wharf Road, *October 14th*, 1848.

Mr. W. Reid, 25, University Street.

Sir,—We this day forward to your address the length of cotton-covered wire coated with gutta-percha. In coating any future quantity, we should prefer to have the wire without any covering of cotton. Enclosed is sample so coated.

We are, yours respectfully,
(Signed) THE GUTTA-PERCHA COMPANY,
*Per* SAM STATHAM.

### Heating by Electricity.

The apparatus for heating water by means of an incandescent lamp, shown in the figure, is now being manufactured and sold under license by the Edison and Swan United Company. The figure is from a block made by the Swan Electric Engraving Company from one of the early apparatus made by Messrs. Miller & Woods, the patentees.

Scarcely any explanation is required. The base of the pot is hollow, like the bottom of a champagne bottle, and the lamp passes up inside, the bottom of the pot being closed up by a metal reflector having a circular hole in it, through

which the neck of the lamp passes into the lampholder fixed on the base. A small amount of light passes out below the reflector through a ring of glass just above the cap of the lamp, and is reflected by the white base below. This light is more than sufficient to use the apparatus by in a bedroom, and it is this that distinguishes it from all other electric kettles, &c., as well as the fact that lamps of various candle-power can be readily inserted, and the water kept hot with an 8 C.P. lamp, boiling with a 16 C.P., or rapidly boiled with a 50 C.P.

It is an undeniable fact that no heat is absorbed by either the vacuum of the lamp or the narrow air-space that surrounds it, and therefore these cause no loss in efficiency. As most bedrooms are only wired for a few lamps; a 50-C.P. is the largest that can be conveniently used. The efficiency is then between 75 to 80 per cent. in hot water, about 10 per cent. loss being in the metal of the pot, and the remainder in radiation. By slightly altering the construction, and making the lamp unremovable, a few per cent. in efficiency can be gained, but at a great loss of convenience. The cost to boil the pot full of water is one-third of a penny, at 6d. per unit. It holds $\frac{3}{4}$ pint, so that, say, for shaving purposes, the cost does not average more than a penny per week.

**Miller & Woods.**
*July 25th*, 1893.

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### Electro-Cyanide Gold Extraction.

Referring to the criticism which appeared in your journa on the 21st inst. on the subject of Mr. J. B. Hannay's electro-cyanide gold extraction process, and in the course of which the writer casts some doubt on the feasibility of this new method of treating refractory ores, I beg to say that I shall be glad, at any time, to put at the disposal of that gentleman, or any expert in such matters, the plant erected by me at 52, Queen Victoria Street, so that he may satisfy himself by an independent test as to the truth of the claims made for it. I may further add that this offer was made by Mr. Hannay himself to every one present on the occasion referred to.

**Alexander Cruickshank.**

## ELECTRIC LIGHT PROVISIONAL ORDERS.

THE following applications for Provisional Orders have been received by the Board of Trade since the date of the last report:—

| Title of Order and Description of Area. | Name of Promoters. |
|---|---|
| Altrincham and Bowdon Electric Lighting Order. The Local Board Districts of Altrincham and Bowdon and a portion of the District of the Rural Sanitary Authority for the Altrincham Union. | Manchester Edison-Swan Company, Limited. |
| Barnet Local Board Electric Lighting Order. The District of the Local Board. | The Local Board. |
| Beckenham Electric Lighting Order. A portion of the Parish of Beckenham. | Do. |
| Bridgend Electric Lighting Order. The Urban Sanitary District of Bridgend. | Do. |
| Brighton Electric Supply Order. The Municipal Borough of Brighton. | Brighton and Hove Electric Light Company, Limited. |
| Colchester Electric Lighting Order. The Borough of Colchester. | Corporation. |
| Eccles Electric Lighting Order. The Municipal Borough of Eccles. | Do. |
| THE COUNTY OF LONDON— | |
| Hackney Electric Lighting Order. The District of the Board of Works for the Hackney District. | The Board of Works. |
| Hammersmith Electric Lighting Order. The Parish of Hammersmith. | The Vestry. |
| Islington Electric Lighting Order. The Parish of St. Mary, Islington. | Do. |
| Islington Electric Lighting Order. The Parish of St. Mary, Islington. | County of London Electric Lighting Company, Limited. |
| Poplar District Electric Lighting Order. The District of the Board of Works for the Poplar District. | The Board of Works. |
| St. Mary, Islington (North) Electricity Supply Order. A portion of the Parish of St. Mary, Islington. | Holloway Electricity Supply Company, Limited. |
| Newcastle-upon-Tyne Electric Lighting Order. The City and County of Newcastle-upon-Tyne. | Newcastle-upon-Tyne Electric Supply Company, Limited. |
| Newmarket Electric Lighting Order. The Urban Sanitary District of Newmarket. | British Electric Light Company, Limited. |
| Partick Electric Lighting Order. The Burgh of Partick. | The Commissioners of Police. |
| Reading Electric Supply Order. The Borough of Reading. | Reading Electric Supply Company, Limited. |
| Taunton (Corporation) Electric Lighting Order. The Municipal Borough of Taunton and a portion of the District of the Taunton Union Rural Sanitary Authority. | Corporation. |

Of these applications (18 in number) 11 were made by local authorities, and 7 by companies, while 6 related to the County of London.

In one instance an application was received from the local authority, and another application from a company, for the same area, and a second company applied for an order in respect of a portion of that area. An order was granted to the local authority, and the applications of the companies were refused.

The following statement shows the manner in which the various applications have been dealt with:—

| Title of Order. | How dealt with. |
|---|---|
| Brighton Electric Supply Order. | The promoters failed to produce the consent of the local authority, and the Board of Trade directed that a local inquiry should be held. After consideration of the report made by the inspectors appointed to hold the inquiry, the Board of Trade were of opinion that no reasons had been advanced sufficient to justify them in dispensing with the consent of the local authority, and refused to grant the order. The local authority are themselves supplying electrical energy under a provisional order obtained in 1883. |
| Altrincham and Bowdon Electric Lighting Order. | Order granted. |
| Barnet Local Board Electric Lighting Order. | Do. |
| Beckenham Electric Lighting Order. | Do. |
| Bridgend Electric Lighting Order. | Do. |
| Colchester Electric Lighting Order. | Do. |
| Eccles Electric Lighting Order. | Do. |
| THE COUNTY OF LONDON— | |
| Hackney Electric Lighting Order. | Do. |
| Hammersmith Electric Lighting Order. | Do. |
| Islington Electric Lighting Order (Vestry). | Do. |
| Islington Electric Lighting Order (County of London Electric Lighting Company, Limited). | An order was granted to the Vestry, and this application was refused. |
| Poplar District Electric Lighting Order. | Order granted. |
| St. Mary Islington (North) Electricity Supply Order. | An order was granted to the Vestry, and this application was refused. |
| Newcastle-upon-Tyne Electric Lighting Order. | Order granted. |
| Newmarket Electric Lighting Order. | The promoters failed to produce the formal consent of the local authority, and the Board of Trade, for the reasons stated in the special report made by them and presented to Parliament, decided to dispense with the consent of the local authority, and granted the order. |
| Partick Electric Lighting Order. | Order granted. |
| Reading Electric Supply Order. | Do. |
| Taunton (Corporation) Electric Lighting Order. | Do. |

Bills Nos. 1, 2, 3, 4 and 7, to confirm the orders relating to Altrincham and Bowdon, Barnet, Beckenham, Bridgend, Colchester, Eccles, Hackney, Hammersmith, Poplar, Newcastle-upon-Tyne, Newmarket, Partick and Taunton, were introduced into the House of Commons on the following dates, viz.:—Nos. 1 and 2, on March 29th; Nos. 3 and 4 on April 25th, and No. 7 on May 30th.

Bills Nos. 5 and 6, to confirm the orders relating to Reading and Islington, were introduced into the House of Lords on May 8th.

Bills Nos. 2 and 3 received Royal Assent on June 9th. Bills Nos. 1 and 4 to 7 are still before Parliament.

The Bills to confirm provisional orders granted by the Board of Trade last year, which were before Parliament at the date of the last report, all received Royal Assent.

In the following instances the Board of Trade have approved deeds transferring to limited companies the powers, duties and liabilities (with certain exceptions) under provisional orders granted to local authorities.

| Title of Order. | Originally granted to | Transferred to |
|---|---|---|
| The Cambridge Electric Lighting Order, 1890. | The Corporation of Cambridge. | The Cambridge Electric Supply Company, Limited. |
| The Hove Electric Lighting Order, 1890. | The Hove Commissioners. | The Hove Electric Lighting Company, Limited. |

### LICENSES.

The following applications for licenses have been received since the date of the last report, and have been dealt with in the manner shown below:—

| Name of local authority or company applying and name of district. | How dealt with. |
|---|---|
| Crystal Palace District Electric Supply Company, Limited. (Portions of the following districts, viz., parishes of Lambeth and Camberwell, districts of the Lewisham District Board of Works and of the Beckenham Local Board and Borough of Croydon.) | Still under consideration. |
| Pontypool Electric Light and Power Company, Limited. (District of the Pontypool Local Government Board). | License granted January 21st, 1893. |
| The Corporation of Taunton. (The Municipal Borough of Taunton). | License granted February 3rd, 1893. |

Of the applications for licenses referred to in the last report, that of the Ogmore Valley Electric Light and Power Supply Company, Limited, was granted on September 16th, 1892. The others are still under consideration.

## NOTES.

**Obituary.**—It is with deep regret that we have to record the death of Mr. Samuel Edmund Phillips, which occurred somewhat suddenly at his residence at Shooter's Hill, Kent, on Saturday last, the 22nd inst., in his 46th year. He had been in failing health for some years, and suffered greatly from an internal complaint which proved to be caused by an ulcer. Mr. Phillips, when a boy, was brought into contact with telegraphy, his father, Samuel Elkins Phillips, whose death we recorded a few weeks ago, being at that time engaged with Dr. Whitehouse in carrying out experimental work in connection with the first Atlantic Cable. He subsequently accompanied his father in the first Malta and Alexandria Cable expedition, and in 1863 he became a member of the staff which Colonel Patrick Stewart formed to go out with the Persian Gulf Cable, remaining at Bushire as a junior clerk. At the end of three years' service he returned to England, and obtained an appointment on the electrical staff of Messrs. Latimer Clark, Forde & Co., leaving these gentlemen to become electrician to Mr. W. T. Henley, in whose service he remained for ten years. At Mr. Henley's works he was appointed manager of the cable department, and occasionally he accompanied cable expeditions as head of the electrical department. In 1875 he joined Mr. W. Claude Johnson in partnership, and a small works was established at Charlton. This formed the nucleus of the present extensive range of factories which are so well known to all connected with the electrical industry throughout the world. As an inventor, Mr. Phillips has given us the oil insulator, which has not only been largely adopted for telegraph lines in India, Egypt, and other countries, but has proved of immense value for overhead lines for electric lighting and the transmission of power in all quarters of the globe. Mr. Phillips took the keenest interest in scientific matters generally, and to his good judgment and sound common sense may be attributed in a great measure the success of his undertakings. His genial manner and generous nature made him a universal favourite, and his loss will be deplored by a very wide circle of friends and acquaintances.

**Electroplating Ships' Bottoms.**—A *Scientific American* correspondent (Mr. J. D. Darling) writes to that journal as follows regarding a recent article published by them, which was concluded thus:—"But invention has not yet reached the point of adequately protecting a ship's bottom from barnacles and seaweed." "What is the matter," says Mr. Darling, "with electroplating them with copper? The first expense, of course, would be great; but the actual cost of plating a large ship after the first expense for solutions, dynamos, and a suitable dry dock, would not be excessive. At first glance there are other objections that appear. The difficulty of keeping a large surface of iron clean until the first coat of copper could be deposited is one. This can be overcome by a plan I used to keep the surfaces of the iron columns for the Philadelphia Public Buildings clean. They had each a surface of about 300 square feet; but after being pickled and freed from rust and scale, there was no trouble in keeping the exposed iron surface clean and free from oxide until such time as they could be got into the plating tank, and as they weighed about 6 tons, this took some time. Another objection is that copper deposited from a solution of sulphate of copper always contains pin holes, which, of course, would admit the sea water, and set up galvanic action between the copper and the iron of the hull; also that the surface of the deposited copper would be rough, and thus interfere with the sailing qualities of the ship. These objections I have overcome by the use of a new plating solution that deposits copper in a much finer and more dense state than that deposited from the ordinary sulphate solution. Copper deposited from this new solution is entirely free from pin holes, and the surface, no matter how thick the coat, is perfectly smooth. It also adheres much better than ordinary plating, which is of great advantage, as there will be less danger of its being torn off by the accidental grounding of the ship in a sand bar. In fact, there would be little danger of the copper being torn off anyway, as copper, when properly deposited on a clean iron surface, adheres very firmly, and nothing short of striking a rock, or other equally hard obstruction, would injure it."

**American History.**—In the *Electrical World*, N.Y., Mr. Thomas D. Lockwood is writing up the history of electrical discovery in America: "From the Centennial Exposition to the World's Fair." It is a mere outline of electrical progress in telegraphy, lighting, literature, &c., containing nothing specially interesting.

**Pure Electricity.**—*Apropos* of the recent discussions on the education of electrical engineers, an American contemporary thinks that opinions as to the relative weight of pure electricity and mechanical engineering plainly depends upon the point of view. *Query:* What is the weight of a coulomb, from the point of view of pure nonsense?

**Electric Traction.**—From what the Chairman of the Liverpool Tramways and Omnibus Company said at the company's last week's meeting, it appears that the directors intend making "another attempt to apply electric power as a means of haulage of tramway cars." They have tried electricity on their lines before, but "for commercial reasons" it did not serve their purpose.

**The Collapse of Ford's Opera House.** — A telegram from Washington, on 24th inst., states that Colonel Amsworth, the Chief of the Record and Pension Division of the War Department, Mr. Dant, the contractor employed in making the excavations for the installation of the electric plant, Mr. Covert, the superintendent, and Mr. Sasse, the engineer of Ford's Opera House, have been indicted, and are held responsible for, the recent collapse of that building, and the consequent loss of life. We referred to the disaster in these columns at the time it occurred.

**Technical Education in Europe.**—Under this title in the *Electrical World*, N.Y., Mr. Frank C. Perkins gives an extended description of the various technical schools throughout Europe. The illustrations of German institutions are alone sufficient to make any British professor envious. The most prominent are those at Dresden, Braunschweig, Darmstadt, Charlottenburg, Karlsruhe, Stuttgart, München, and Leipzig. The institutions of Zurich, Switzerland; Vienna, Austria; Berlin, Germany; are regarded as the finest on the Continent. The series of articles is not yet complete, so that at present no comparison is made of English technical schools.

**Rules of Direction.**—The direction of motion of a conductor, through which a current is flowing, has been set forth in so many rules, that there scarcely seems a need for suggesting new ones. In an article upon the subject in the *Electrical World*, N.Y., by Mr. B. B. James, we are given one which is said to include all cases, and to leave no doubt. We may state it thus: "Any conductor carrying a current in a magnetic field, other than its own, tends to move at right angles, both to itself and that component of the field normal to itself, *and towards that side on which its own lines of force, and those of the field, go in opposite directions.*" The converse of this amended law give the direction of generated currents: "The generated current has such a direction that the lines of force, on the side towards which it is advancing, are in the same direction as those of the influencing field."

**Field Explorer.**—Messrs. Hartmann & Braun have introduced an apparatus for exploring the magnetic field, depending upon the variation in resistance of bismuth when magnetised. Labuc gives the following formula for this change:

$$H = a\sqrt{\frac{r}{R}\left(\frac{r}{R} + b\right)},$$

where H is the intensity of field, $r$ the variation of resistance to a change in the intensity of field from O to H, $a$ and $b$ are constants. The bismuth wire is wound into a flat, inductionless, spiral—it is quite small. Pure bismuth is far more sensitive for the purpose than the commercial varieties. For this purpose electrolytic bismuth is used. The above law holds for fields up to H = 600, after which the straight-line law is used. For intense fields there is a variation of nearly 50 per cent. in resistance. The apparatus is described in *La Lum. Elec.* for June 10th.

**Traction at Essen.**—The electric tramway on the trolley system is now practically complete. Experimental runs with the ten cars already received are now being made, and the line is to be started for traffic on August 15th.

**The Proposed Glasgow Municipal Telephone System.**—If the recommendations of the Finance Committee of the Town Council are adopted, the Corporation will furnish about £50,000 for the purpose of establishing an efficient telephone service for the city, pending the acquisition of Parliamentary powers for the purpose.

**Bristol Electric Lighting.**—"Damocles," writing to the *Western Press*, says that the Bristol Town Council are doing things by halves. He seems to consider that this charge is confirmed by the action of that body in omitting to include West Street, St. Phillips, Bristol, in the district, to be electrically lighted. From what he says, it appears that West Street is one of the main arteries of the city, having three or four branches of banks established there. He suggests that the tradesmen of the street in question should appoint a deputation to the Lighting Committee and ventilate their grievance.

**More Electric Railways Wanted.**—A correspondent of the *Railway News*, who is evidently an enthusiast as regards electrical railways, suggests that one should be laid down from North-West London to Victoria. He even ventures so far as to propose what he considers the best route for such railway, *i.e.*, from Finchley Road, close to the North Western, Midland, and Metropolitan Stations, with perhaps a covered way and through booking from all three companies over the electric railway. He further states that electric railways will best serve the public by taking only suburban traffic, and establishing a connection with each other by exchange stations at various points. There are probably a number of suburban residents who could make proposals equally as important as Mr. Barlow's regarding more rapid and convenient railway travelling to and from the metropolis. We are, however, afraid he will have to wait yet a little while for his desire in this direction to be gratified.

**Boiler Flue Cover**—Mr. G. C. Taylor, of Helsby, has recently brought out a new removable boiler flue cover and fire-proof composition. In the ordinary boilers of the Lancashire and Cornish horizontal type, the covering over the top of the flues is bricked over, and is removed with great difficulty when an examination of the boiler has to be effected. In the new arrangement patented by Mr. Taylor the brickwork is not carried over the flues, but the latter are closed over by a flat cover, over which composition is placed, sealing up the flue entirely. The edges of the plates which abut against the boiler are held up by saddle irons, which pass over the boiler. Neither the flue plates nor the saddle irons are attached to the boiler, which is thus free to expand without a mass of brickwork resting upon it. The arrangement is stated to be a very satisfactory one, and as far as can be judged, it appears to be a very distinct and valuable improvement on the usual method of building up the flues.

**The Cambridge Summer Meeting.**—The Cambridge Syndicate for Local Lectures has issued a programme of the Fourth Summer Meeting to be held at Cambridge, July 29th to August 26th. The course of study provided will be divided into two main sections and a miscellaneous section. Section A will consist of courses of practical work in science in the University laboratories and museums, and of a set of lectures intended to illustrate the progress of scientific study. The course is arranged to extend over the whole of the month represented by the above dates. We note that the lectures are for the most part to be illustrated by experiments, lantern slides, or diagrams. The department of electricity and magnetism is, so far as the practical work is concerned, placed under the care of Mr. W. Cassie, M.A., Trinity College. A demonstration followed by practical work at the Cavendish Laboratory takes place every other morning at 12 o'clock. The programme fills 32 pages, and contains every needful information, from lists of lectures and classes to lists of lodgings, and from cab fares and boating charges to special sermons.

**Waterloo and City Electric Railway.**—The Lords' amendments to this Bill were considered in the House of Commons on Tuesday.

**Cardiff Lighting.**—Complaints are being made regarding the dreadful condition of the public gas lamps and burners at Cardiff. The report of the lighting inspector states that altogether there were 409 street lamps in a defective condition, and the Gas Company are being remonstrated with by the authorities on the matter.

**Electric Lighting in Berlin.**—The financial year, 1892-93, of the Berlin Electricity Works, closes with 105,094 glow lamps, 5,405 arc lamps, and 216 motors, of a total of 800 H.P., connected to the mains, as compared with 87,763 incandescent and 4,516 arc lamps, and 120 motors of 430 H.P. in the previous year. The number of consumers increased from 1,782 to 2,100, and applications are now in hand, representing 19,000 lamps, and 20 electro-motors.

**Appointment.**—We have pleasure in tendering our congratulations to Mr. Alfred H. Gibbings on his appointment as electrical engineer to the Hull Town Council. This gentleman has lately been superintending the electric lighting of Hove on behalf of the Commissioners; he is an Associated Member of the Institution of Electrical Engineers, and an occasional contributor to our columns on matters pertaining to municipal electric lighting.

**Islington appoints an Engineer.**—Mr. Albert Gay has been appointed resident engineer for the electricity works. There were fifty-three applications for the post. We compliment Mr. Gay on his success.

**The Azores Cable.**—In the French Chamber of Deputies on Thursday last week, during the debate on a credit of 400,000 francs proposed as compensation to the French Cable Company, which tendered for the laying of the Azores cable, but whose offer was rejected by the Government, M. de Ramel reproached M. Siegfried, who was Minister of Public Works at the time, with having given the death blow to the French company by granting the concession to an English company. M. Siegfried repudiated the insinuations, and explained that as the English company undertook to perform the work at a cheaper rate than the French company, he rejected the latter's tender.

**London Telephone Service.—An Important Decision.**—On Tuesday last the City Commissioners of Sewers passed a very important resolution; important especially in its bearing upon the City of London Electric Lighting Company, if we may judge from the remarks of Sir David Salomons at the last meeting of that company. Under an agreement with the New Telephone Company, the electric lighting company, when laying their mains in the city, laid a number of spare tubes along their district with a view to providing "an efficient telephone service for London." It was, however, necessary to obtain the consent of the Commissioners to the utilisation of these tubes for the purpose stated, as well as the consent of other authorities. After various delays this request was on Tuesday granted conditionally. The conditions are that the telephone service to be supplied is to be on the twin-wire system, and the citizens are not to be charged more than £8 per annum.

**St. Pancras Electric Lighting.**—A special meeting of the vestry was held last week to consider Mr. Clements's memorandums on the electric light installation, and Mr. Gibb's replies thereto; also to resume the debate on the adjourned joint report of the Electricity and Dusting and Slopping Committees, recommending the combination of the destruction of refuse with the production of electricity, at the station in King's Road. Discussion took place on the adjourned joint report of the two committees, and to which the following amendment had been moved by Mr. Cox, "That the vestry is not prepared to entertain the question of any other electric lighting installation until the present installation has been in complete working order for at least two years." This amendment was negatived by 51 against 22 votes, and the committee's recommendation adopted.

**The County Council and St. Pancras Electric Lighting.**—The London County Council, at their meeting on Tuesday, resolved to lend St. Pancras Vestry £14,500 towards the electric lighting works in that district.

**Hanley Electric Lighting Loan.**—The Town Council are applying to the Local Government Board for an order consenting to the creation of stock for the purpose of raising certain loans which have been sanctioned. One of the loans is for £21,000 for 25 years for electric lighting purposes.

**Overhead Wires at Weybridge.**—The Chertsey Rural Sanitary Authority have resolved to communicate with the Weybridge Electric Supply Company drawing their attention to section 82 of the lighting order for Weybridge, which limits the time for removing the electric lines placed above ground, and stating that the Authority did not consent to the lines remaining above ground in contravention of that order.

**An Electrician Drowned.**—We regret to hear that Mr. W. C. Palmer, assistant electrician to the General Electric Power and Traction Company, Limited, was drowned in the Thames on Saturday evening, the 22nd inst., whilst on duty. Mr. Palmer has only recently joined this firm, and his untimely death is extremely regretted by all, especially those associated with him in his profession.

**Dublin Electric Tramways.**—Mr. S. Hoare's Committee, on Tuesday, had before them the Dublin and Southern District Tramways Bill, in regard to which the Committee proposed to insert the model clauses recently adopted by the Joint Committee on Electric Powers. The Telephone Company objected to this course, but as a result the clause, with modifications, was agreed to, the Telephone Company stating that it was not to be regarded as a precedent for their action in regard to future cases.

## NEW COMPANIES REGISTERED.

**Electric Construction Company, Limited** (39,292).—This company was registered on the 20th inst. with a capital of £400,000, in 200,000 £2 shares, whereof 150,000 are ordinary and 50,000 preference; to acquire the undertaking and assets of the Electric Construction Corporation, Limited, upon such terms and conditions as the board think fit, and to carry on the business of electric and mechanical engineers and electricians; to manufacture appliances and apparatus of every description applicable for, or in connection with, the supply or use of electricity or magnetism for any purpose, and to generate, accumulate, distribute, and supply electric, magnetic, or other force, for the purposes of light, heat, sound, or motion. The subscribers (with 1 share each) are: Daniel Cooper, 6, De Vere Gardens, W., baronet; D. Plunket, Q.C., M.P., 12, Mandeville Place, W.; E. Garcke, Queen Street Chambers, E.C., director; H. C. Mance, Bedford, K.B., &c.; T. Parker, Newbridge, Wolverhampton, M.I.C.E.; P. E. Beachcroft, 112, Portsdown Road, Maida Vale, W., manager; J. W. Barclay, 5, Clarendon Place, S.W., merchant. The first directors are: Sir D. Cooper, Bart., G.C.M.G.; Sir H. Mance, C.I.E.; the Right Hon. D. Plunket, Q.C., M.P.; J. W. Barclay, P. E. Beachcroft, J. D. Courtenay, J. Pender, and E. Garcke; qualification, £400; remuneration, £1,500 per annum, and percentage on profits. Registered by Linklater & Co., 2, Bond Court, E.C.

**District Messenger Company of Paris, Limited** (39,302).—This company was registered on the 22nd inst. with a capital of £200,000 in 192,000 £1 ordinary shares and 400 £200 founders' shares, to enter into an agreement made with C. T. Russell: to manufacture, fit up, let or sell, electrical appliances of all kinds for the transmission, communication, or making in any way of messages and signals; to generate, purchase, supply, and apply electricity for any purpose and in any manner; to manufacture, hire, let, and deal in electrical appliances of all kinds; to engage and provide messengers, &c., and to collect, acquire, print, publish, and distribute news and information on any subject and in any form. The subscribers (with one share each) are:—W. J. Chilton, Norton, Stockton-on-Tees, engineer; H. B. Stevenson, Nawood Lodge, Middlesborough, engineer; W. H. Budd, 25, Manor Road, S.W., gentleman; H. W. Roger, 4, Greville Road, Richmond, solicitor; Name undecipherable, 50, West Hill, Putney, solicitor; A. F. Solomon, Leatherhead, Surrey, gentleman; R. F. Yeo, Drayton House, Ealing, gentleman. The number of directors is not to be less than five nor more than fifteen. Qualification £50. Remuneration, £1,750 per annum, to be divided amongst them. The chairman is to receive £50 a year in addition to the ordinary remuneration. Registered by Ashurst, Morris, Crisp & Co., 17, Throgmorton Avenue, E.C.

**Rugby School Electric Lighting Company, Limited** (39,309).—This company was registered on the 24th inst., with a capital of £5,500, in £50 shares, to carry on at Rugby the business of an electric lighting company in all its branches, for the purposes of supplying electricity for lighting or other uses to the boarding houses and buildings of, or connected with the school, and to manufacture and maintain all requisite appliances and apparatus. The subscribers are: J. Percival, School House, Rugby, head master of Rugby, 2 shares; J. Collins, Hillmorton Road, Rugby, assistant master, 5 shares; F. D. Morice, 10, Hillmorton Road, Rugby, assistant master, 2 shares; A. E. Donkin, 5, Barby Road, Rugby, assistant master, 2; W. G. Michell, 3, Hillmorton Road, Rugby, assistant master, 6 shares; G. Stallard, 15, Bilton Road, Rugby, assistant master, 2 shares; C. G. Steel, Barby Road, Rugby, assistant master, 2 shares. Table A mainly applies. Registered office, Dunchurch Road, Rugby, Warwick.

## CONTRACTS OPEN AND CLOSED.

### OPEN.

**Bolton.**—August 3rd. For the supply and erection of alternators and dynamos, for the Gas and Lighting Committee. Specification and form of tender may be obtained on application to Mr. J. H. Rider, M.I.E.E., borough electrical engineer.

**Derby.**—August 9th. Wiring of public library, museum and art gallery. Copies of specification, &c., can be obtained on application to Messrs. Bramwell and Harris.

**Richmond (Surrey).**—August 2nd. For the supply and laying of electrical fire calls within the borough for the Town Council. Detailed specification and forms of tender can be obtained at the office of Mr. F. B. Senior, town clerk, Town Hall, Richmond.

**St. Pancras.**—Tenders are wanted for extensions of electric light works. Full particulars will be found in our advertisement columns.

### CLOSED.

**Bank Lighting.**—The London and Brazilian Bank, Tokenhouse Yard, have accepted the estimate of Messrs. Drake and Gorham, for the re-wiring of their offices, for about 80 lamps.

**Worcester.**—The tender of Messrs. Rowland & Son, of Coventry Road, Birmingham, for the erection of a generating station at the cost of £14,797, has been accepted by the Town Council.

## BUSINESS NOTICES, &c.

**J. A. Berly's Universal Electrical Directory** for 1893 (12th year), 784 pp. This standard work contains a larger amount of trade information than any other similar publication, and should be in the hands of every engineer or electrician. Free within the Postal Union for 4s.

**J. Slater Lewis's Bankruptcy.**—On 20th inst., in the Birmingham County Court before his honour, Judge Chalmers, Mr. Joseph Slater Lewis, formerly of the National Telegraph Works, came up for final examination. Most of the facts elicited at the examination have been previously stated in the columns of the ELECTRICAL REVIEW. The receiving order was made on a creditor's petition in April, 1892. Liabilities amounted to £1,613. Assets had been received by the official receiver £49 13s. 4d., nearly all of this sum being paid voluntarily by the bankrupt out of his salary of £300 per annum. In 1885 bankrupt who was at the same time connected with several other concerns, sold the electrical engineering business which he had been carrying on at Helsby to the Telegraph Manufacturing Company, of which he was managing director until 1889. He

next negotiated for the promotion of a telegraph company in Birmingham. These negotiations fell through, and he was awarded £450 as a retainer. In 1891, he, along with Messrs. Fowler, Lancaster & Co. formed the Birmingham Telegraph Factory, Limited, and was appointed managing director. Here he remained until August, 1891. In July, 1891, there had been further negotiations, this time with Mr. Richard Tangye for the flotation of a new electrical company; these negotiations, however, also fell through, and bankrupt received £750 for his trouble. He next started business at Aston with £525. In November of the same year he started a company under the name of the National Telegraph Works Company with a capital of £5,000, consisting of seven shareholders—the bankrupt and six of his employés — 531 shares of £5 each were allotted but no others. Debentures amounting to £800 were issued and formed the capital of the company. The company wound up in February, 1892, but the assets did not realise sufficient to pay any dividend to creditors. In the course of the examination a letter was read from Mr. Walter T. Goolden (Messrs. W. T. Goolden & Co.), stating that Mr. Slater Lewis had been for fifteen months holding a responsible position as works manager at his establishment, and the considered him incapable of any unquestionable conduct. He was a man of great energy and ability, and he (Mr. Goolden) had formed a very high opinion of his character. Mr. Llewelyn B. Atkinson also personally attended the court in order to speak on bankrupt's behalf if necessary. The official receiver contended that bankrupt had contributed to his bankruptcy by rash and hazardous speculation. The judge, in giving his decision, commented on the bankrupt's attempt to float a company. No doubt the bankrupt hoped and fully and honestly believed that the company would be a success, but nevertheless he must say that when a man started a company and incurred debts on behalf of a future company he was really risking his creditors' money instead of his own. Rightly or wrongly, under the existing law a man could practically start a company, of which he himself was the sole manager, being in effect the company itself. He commented very strongly upon the present unsatisfactory condition of "company" law, and hoped it would soon be altered. He considered the bankrupt intended to act honestly, but his discharge would be suspended for three years.

**Electric Lighting of the Central Markets.**—The City authorities were last week engaged upon consideration of a petition presented by Sir David Evans on behalf of Messrs. Julius Sax & Co. The ultimate issue of this petition will be of much importance to Messrs. Sax, who besought that a building lease, for 80 years, of land in Charterhouse Street might be granted to them on certain conditions at a ground rent of £500 per annum. Messrs. Sax, in their petition, stated that if a longer lease than 21 years was not granted to them of the land in question, their endeavours would not be successful. They undertook to surrender the land again to the Corporation in case it was required for market purposes. Mr. Sax in the course of evidence before the Commissioners, said that it was their intention to use the whole of the space for the lighting of the markets, and it was impossible to carry out their contracts under existing circumstances. The absolute sum fixed by the petititioners, which would be accepted for the removal of their premises in case the Corporation needed the land, is £7,000; this was the sum they proposed to expend upon the erection of the new buildings. An amendment that the compensation clause be altered to £4,000 received no seconder, and eventually the whole matter was referred to the Markets Committee for consideration and report.

**Worcester Electric Lighting.** — The City Surveyor recently presented a report upon the alternative schemes of erecting a generating station for electric lighting in the city, with the use of steam power only, and having a generating station at Powick, where water power was obtainable. The total sum likely to be saved in initial outlay by adopting the former scheme was £15,000; but, on the other hand, there would be, by the adoption of the latter, a saving in annual cost, and the store water could be used for other purposes, to realise an annual value of £4,000 for an expenditure of £600 a year. The special sub-committee appointed for the purpose recommended the Powick scheme. They also recommended to the Council the acceptance of the tender of Messrs. Rowland & Son, of Coventry Road, Birmingham, for the work at a cost of £14,797.

**The Annual Outing of the General Electric Company.** —Last Saturday was a good day in every sense for the annual outing of the London employés and friends of the General Electric Company to Monkey Island, Bray. The weather was everything that could be desired, and the whole programme passed off most satisfactorily and pleasantly. In the sports, which, as usual, were numerous, the Scotchmen were well to the fore and carried off several prizes. The trip up the river in steam launches was also excellent, the scenery being greatly enhanced in picturesqueness by the effect of the sun after the plentiful rain which had previously fallen.

**City and South London Railway Extensions.**—Lord Morley's Committee of the House of Lords have passed the Bill promoted by the City and South London Railway Company for an extension of time within which to complete their authorised extension from Stockwell to Clapham. Powers are also given empowering them to extend their system from King William Street to Islington. These powers have now been sanctioned by both Houses.

**Lighting of Frankfort-on-the-Maine.**—The report of the majority of the commission appointed to consider the tenders received for the lighting of this town recommends the adoption of the offer of Messrs. Brown, Boveri & Co., for an alternating current system, the station to be worked by the municipality, or leased to the contractors.

**Anglo-American Telegraph Company.** — "Equity," who is evidently a shareholder in this company, writes to the *Financial Times* airing an oft-repeated grievance among the shareholders of companies. He complains that the company is in the singular and unique position of having a reserve or renewal fund of over a million pounds, while one-half its shareholders receive no dividends. "Equity" hopes there will be a full attendance at the forthcoming meeting (to be held to day), and that the following steps will be taken to alter the shareholders' position: (1) Alter the articles of association; (2) secure an adjustment of capital; and (3) appoint a directorate with less divided interests.

**The Amsterdam Swindlers.** — The matter of the Amsterdam frauds, to which we have made repeated reference in these columns, is again referred to in the daily papers by the British Consul at Amsterdam. He states that in spite of his many warnings to British traders, the evil continues apparently unabated, judging by the correspondence which continually reaches him from British firms which either have been victimised, or have written for further information before executing the orders received. He further states that he has more than 120 names on his black list in Amsterdam alone, which fact speaks sufficiently of the enormous extent and lucrative nature of the underhand business being carried on.

**A Novelty at Broad Street Station.**—The North London Railway Company, with a view to enhancing the fund at present being raised for the benefit of the wives and families of the men who met their deaths so unexpectedly at Skegness a few weeks ago, have placed on exhibition at Broad Street Station, a working model (one-eighth size) of one of their locomotives. Placed as it is at a conspicuous part of the general platform, the attention of passengers is easily secured. Arrangements have been made whereby anyone may place a penny or a florin in a slot, which operation sets the engine working and lights a number of tiny electric lamps at various parts of the engine.

**Russell & Co.**—A new catalogue has been brought out by this firm which they devote entirely to engines and boilers. The following are some of the specialities dealt with:—the Galloway boiler, Manchester boiler, locomotive type boiler, return tube marine boilers, vertical boilers; horizontal fixed and various other types of engines. A double page plate of an improved undertype compound engine and boiler is bound in the centre of the pamphlet. Triple expansion engines for electric lighting and ship lighting plant are also accorded a certain amount of space. Further, towards the end, is a double page plate of a 100-unit steam turbine; gas and oil engines are also referred to.

**Middlesborough Town Hall Tenders.**—A meeting of the Middlesborough Electric Lighting Committee was held last week, at which tenders were submitted by the Brush Electric Lighting Company; Messrs. Stevenson & Cowper, Middlesborough; and Messrs. Holmes & Co., Newcastle, for the lighting of the Municipal Buildings and Town Hall by electricity, together with four arc lamps, one at each corner of the buildings. That of Messrs. Holmes & Co., at £2,980, was the lowest, but it was decided to recommend the Council, having regard to the present financial position of the town, and other pressing circumstances, not to entertain the question at present.

**The Question at Shrewsbury.**—The Town Council convened a special meeting for last Friday to discuss the electric lighting question. It had, at a previous meeting, been suggested that the time of compulsory purchase of the electric lighting business from the Shropshire Electric Light and Power Company, Limited, should be 21 years. There being some disagreement on this question the special meeting was decided upon. At this meeting the Council consented to reserve power to themselves to purchase the undertaking from the company at the end of 21, 28, or 35 years at a price to be fixed by arbitration, or otherwise agreed upon.

**Plymouth Electric Tramways.**—A Board of Trade enquiry was held at Plymouth last week regarding the Corporation's application for sanction to borrow £13,000 for tramway purposes. The overhead electric system it was decided, on the recommendation of the committee, not to adopt, and certain parts of the line could not be worked on the accumulator principle as the gradients were so steep on the main line. The authorities it therefore appears have given up the idea of electric traction and decided to work the line by horses. There is, however, so we understand, yet the possibility of one portion of the line being worked electrically.

**Ealing Electric Lighting Tenders.**—The tenders have been opened for the provision and laying of mains, &c., and for the wiring of the public buildings and the provision of fittings and accessories, in connection with the project for the lighting of the district by electricity. Seven tenders were received for the provision of mains, at sums ranging from £8,924 to £6,199; and 26 for the other apparatus needed, the amounts in the case of these latter tenders varying from £2,187 to £684. The tenders were referred to Messrs. Bramwell & Harris for examination and report.

**Lectures.**—To-night at 8 p.m., Mr. George Offor will lecture at Westwood House, West Hill, Upper Sydenham, on "Electricity, as applied to Domestic Purposes." Mr. C. J. Whittuck Rabbits, J P., will preside.

**Electric Cooking.**—At the works of Messrs. Rooper and Harris, Limited, of Stafford, last week, there was an exhibition of electrical cooking apparatus. The Mayor and Mayoress and other visitors were present.

**The Lighting of Killarney Asylum.**—Mr. Walter Leake has presented his report upon the proposed electric lighting of this asylum. He states that there will be required 571 incandescent lamps of 8-C.P., 251 16-C.P., 9 32-C.P., and 6 of 100-C.P. The estimated cost is £1,200. Favourable resolutions have been passed by the Local Board accepting the proposals of Mr. Leake, but from what we read it seems to us that there will be some hot discussion on the subject at the next meeting, a member having given notice of motion to rescind these resolutions.

**National Electric Manufacturing Company.**—A few weeks ago we acknowledged receipt in these columns of a number of catalogues from the National Electric Manufacturing Company, of Wisconsin, and at the same time announced that Messrs. Shippey Bros. had been appointed sole European agents for that company's specialities. We have since received a circular letter from Wisconsin, dated May 24th, in which it is stated that the company is insolvent, and Mr. R. E. Rust, has been appointed receiver.

**Huddersfield Electric Lighting.**—Various tenders have been accepted for the supply of materials required in connection with the works, and it has been decided to extend the mains to Dundas Street, Westgate, and Victoria Lane. A special meeting of the committee has been fixed for Saturday, the 29th inst., at 7 p.m., for the purpose of officially commencing the supply of energy. The appointment of an assistant electrical engineer has been resolved upon.

**Electric Lighting at Manchester.**—Messrs. B. Verity and Sons are carrying out a very large number of contracts from their Manchester house, as follows: Free Trade Hall, Manchester; the Royal Exchange, Manchester; the Free Reference Library (for the Corporation); the Reform Club; complete plant for the Linotype Company's works, and a number of installations on the outskirts of the city, and in connection with the Corporation's supply.

**Edinburgh Authorities Refuse their Consent to a Proposed Electric Tramway.**—A letter was submitted to the Edinburgh Town Council the other day, from the Caledonian Electric Supply Company, with reference to their proposal to construct an electric tramway from Coltbridge to Corstorphine. The Lord Provost's committee has recommended the magistrates and council to refuse to give their consent to the scheme.

**The Oriental Telephone Company.**—In our issue for June 16th, we gave a short account of an appeal to the House of Lords by certain shareholders in this company, calling in question the system of dividing profits as adopted by the directors. Judgment was yesterday delivered in the House, when, by a majority of four against two, the appeal was sustained, and the interlocutor of Mr. Justice Kekewich restored.

**Annual Outings.**—The annual excursion of the employés of the Oxford Electric Company took place last Friday. A launch trip to Dorchester was the chief feature.

The workmen and staff of the Brighton and Hove Electric Lighting Company went to Angmering for their annual outing on Saturday last. They were favoured with the best of weather, and numerous sports were engaged in.

On Saturday last the electricity and wiring staff of the Brighton Corporation Electricity Works held their first annual outing, driving to Heathfield by coach.

**Haddington not to be Electrically Lighted at present.**—Upon examination the water power at the East Mills has been found insufficient to light the town electrically. Messrs. Drake and Gorham recommended that the water power should be supplemented by steam power. The Town Council, however, after a brief discussion, have cast the question aside for the present by twelve votes to five.

**An Electrical Engineer Committed.**—An electrical engineer named Harry Popple residing at St. James' Villa, Aldis Road, Tooting, has been committed for trial on a charge of obtaining money by means of a worthless cheque. When the detective went to his residence to arrest him, Popple was found in his night-shirt concealed underneath the bed, and had to be removed by force.

**The Mansion House Lighting.**—The City of London Electric Lighting Company's bill for current supplied to the Mansion House for the half-year to Midsummer, amounted to the sum of £449 18s. 11d. The Lord Mayor is personally responsible for one-third of the cost of the Mansion House electric lighting. A resolution to this effect was passed by the Commissioners not very long ago.

**Personal.**—We learn that Mr. Fernand Espir (late E. H. Cadiat and F. Espir), of 3, East India Avenue, London, E.C., has been appointed the sole agent in Great Britain and Ireland for the "Société Anonyme pour la Construction de Lampes à Incandescence," of Budapest (The Budapest Incandescence Lamp Company), in view of the expected coming trade in imported lamps.

**Gent & Co., Leicester.**—This firm has recently found it necessary to enlarge its manufacturing premises, and in fact are hoping shortly to remove to workshops better adapted to their extensive business. In the meantime they are making an attractive exhibition of electric lighting and telephony in one of the best positions in the market place.

**Wrexham Electric Lighting.**—The Town Council have decided to negotiate terms for taking over the provisional order of the Wrexham and District Electric Supply Company, Limited, but not to include the adoption or taking over of a provisional contract for works of supply, either with the Brush or any other company.

**Serious Accident at Grimsby Docks.**—Mr. Carl Teves, of Bremen, the representative of a German electrical engineering company met with a serious accident in the Grimsby Dock Basin last week. He had gone to Grimsby to examine the electric machinery of the fishing boat *Matabor*, which is propelled by petroleum and fitted with electric fishing appliances. The vessel was lying on the hard in the dock basin, and Mr. Teves was leaving it when he slipped and fell upon the stonework, fracturing the base of the skull. He was conveyed to the hospital in a critical condition.

**Business Announcement.**—We are informed that Messrs. Appleton, Burbey & Williamson (now Messrs. Burbey, Williamson & Joseph) are no longer London agents for Messrs. Charlesworth, Hall & Co., and all communications intended for the latter firm should be sent direct to the works at Oldham.

**Doulton & Co.**—This firm request us to announce that their patent conduit for underground electric mains, together with a selection of pottery for electrical purposes, which has been exhibited at their Lambeth show-rooms during this week, will remain on view to engineers, on presentation of card, until 5th prox.

**Hertford Electric Lighting.**—The electric lighting scheme drawn up for the Corporation by Mr. J. A. McMullen, M.I.E.E., has been submitted to Prof. Forbes, as the Council wished for a second opinion. Prof. Forbes has reported agreeing with Mr. McMullen's proposals on all important points.

**Electrical Engineering Corporation.**—The *London Gazette* publishes notification of a meeting of the shareholders in this company, to be held at 58, Coleman Street, on August 22nd, at 12 o'clock noon, to have an account of the winding up laid before them, and to pass incidental resolutions.

**Johnson & Phillips.**—This firm, in a circular announcing the death of Mr. Samuel E. Phillips, to which we refer elsewhere in this issue, state that Mr. W. Claude Johnson henceforth becomes sole proprietor of the works and business, which will be carried on upon exactly the same lines as heretofore.

**Hobart Electric Tramways.**—The *Financial Times* of Friday last contained a reprint of an article recently published in the Hobart *Mercury*, showing the stage that has been reached in the execution of the work, and also setting forth a description of the stations and machinery and plant.

**Guildford Proposed Electric Lighting.**—The Holloway Electricity Supply Company, London, have notified the Guildford authorities of their intention to apply for a provisional order authorising them to supply electricity for any public or private purposes within the borough.

**Electric Light in the City.**—Bitter complaints are being made regarding the continued delay in the supply of private electrical current in the City, especially in Newgate Street. The authorities are communicating with the City of London Electric Lighting Company on the subject.

**Measuring and Testing Instruments.**—The Walsall Electrical Company, Limited, have published a revised illustrated price list of these instruments as manufactured by them. Voltmeters, ammeters and galvanometers are the principal articles described.

**Hobart Proposed Electric Lighting.**—A proposal is being considered for lighting the chief streets by electricity. Arc lamps have been recommended for the busy streets, and incandescent lamps for the bye-streets, the Town Hall, and general market.

**Birmingham Electric Lighting.**—The notice to the City Council by the Birmingham Electric Supply Company, of their intention to apply for a provisional order extending their area of supply, has been referred to the General Purposes Committee.

**Richmond Town Council and their Adviser.**—Under this heading in our last issue we stated that "it was decided after consultation with Mr. *Smith*," &c. This, however, should have been Mr. *Small*, of Urquhart & Small, not Mr. Smith, as printed.

**Fire.**—On Tuesday, last week, a very slight damage was caused by a fire breaking out in the premises of the Newcastle Electric Supply Company. Nothing of any serious importance happened beyond a temporary interruption of the supply.

**Redditch Electric Lighting.**—The local board are considering the electric lighting question and have instructed Mr. J. A. McMullen, M.I.E.E., to prepare plans and specifications for a central station, and to get in estimates for carrying out the work.

**Chiswick Electric Lighting.**—The seal of the Chiswick Local Board has been fixed to the deed of transfer and lease to the Bourne and Grant Electricity Supply Company, Limited, as to the provision of electric lighting in Chiswick.

**Blackburn Telephone System.**—We understand that Mr. John M'Lellan, of Blackburn, has just fitted up for Blackburn Corporation a telephone system of 25 stations, connecting the municipal offices, police stations, gasworks, &c.

**Kensington Electric Lighting.**—The Vestry has given their conditional consent to the House-to-House Company for the construction of culverts and the laying of electric mains, &c., along certain streets in their district.

**Merthyr Local Board and Electric Lighting.**—Some correspondence is at present passing between the Birmingham Corporation, the Birmingham Electric Supply Company, and the Merthyr Local Board regarding the proposed lighting of the latter town by electricity.

**Oswestry Electric Lighting.**—The Town Council have given their consent, conditionally, to the request of the Oswestry Electric Lighting and Power Company, who wished to apply for a provisional order.

**Sevenoaks and Electric Lighting.**—The Local Board have notified that they will not oppose the application of the promoters of an electric lighting company at Sevenoaks for a provisional order.

**B. Verity & Sons.**—This firm have sent us copies of printed lists of the various premises installed by them in London and the provinces; also a list of installations at present in progress.

**Kingston-upon-Thames.**—An electrical engineer is wanted to take charge of the construction, and manage the electric lighting works on completion. Salary £150 per annum.

**Mavor & Coulson.**—This firm have completed one of their Sayers feeder compensators for the Midland Railway Company's electric lighting station at Derby.

**Change of Address.**—Mr. Henry W. Handcock has removed to Westminster Chambers, 5, Victoria Street, S.W.

## CITY NOTES.

### The Globe Telegraph and Trust Company, Limited.

THE report of the directors presented at the twentieth ordinary general meeting, held yesterday, reads as follows:—

"The balance-sheet and accounts for the year ending July 18th, 1893, with statement of the stocks and shares held by the company at that date, are herewith submitted. The net revenue of the company for the year, after deduction of expenses, amounts to £188,931 10s. 8d., and makes with the balance of £938 4s. 1d. brought forward, a total of £189,869 14s. 9d. From this amount there has been distributed the sum of £126,300 16s. 8d. in interim dividends, leaving an available balance of £63,568 18s. 1d. The directors recommend the payment of a final dividend for the year of 3s. per share on the preference shares, and of 4s. per share on the ordinary shares, making, with the previous distributions, a total dividend for the year of 6 per cent., less income-tax, upon the preference, and 4⅝ per cent. net (against 4⅞ per cent. for the preceding year) upon the ordinary shares, and carrying forward a balance of £1,304 17s. 9d. The directors report with much regret the death on May 7th last of Sir James Anderson, their valued and much esteemed colleague, who had been a director of this company from the date of its incorporation. The Hon. W. St. John F. Brodrick, M.P., a director of the Brazilian Submarine Telegraph Company, Limited, has been elected to fill the vacancy. Mr. Sidney Collett has been appointed secretary in place of the late Mr. William Payton, whose decease was announced in the last report. Since the last meeting a staff endowment assurance scheme has been carried into effect, the company's contribution being about £100 per annum. In conformity with the articles of Association, Sir Henry Daniel Gooch, Bart., and James Pender, Esq., two of the directors, retire, and being eligible, offer themselves for re-election. The auditors, Mr. John George Griffiths, F.C.A. (Messrs. Deloitte, Dever, Griffiths & Co.), and Mr. William Griffith, B.A., barrister-at-law, also retire, and Messrs. Deloitte, Dever, Griffiths & Co., and Mr. Griffith offer themselves for re-election."

### Liverpool Overhead Railway.

THE report of the directors, prepared for presentation at the tenth half-yearly general meeting of the shareholders, to be held in the Law Association Rooms on Tuesday, August 8th, contains the following, among other particulars:—Owing to the delay in completing the electric signalling, only a 10 minutes' service could be worked until May 22nd, since which date a 5 minutes' service has been established. Your directors have pleasure in reporting that the main structure of the line has been completed, and that the electrical equipment has been working satisfactorily, the traffic being conducted with great regularity. The total number of passengers carried is 1,370,742, of which number 235,487 were first class, 956,922 second class, and 178,333 travelled with the cheap workmen's return tickets which the company have recently issued. A contract has been entered into with Messrs. Holme & King, of Liverpool, for the extension of the railway to Crosby Road, Seaforth, from which considerable additional traffic is expected. The directors have decided to ask the shareholders for authority to issue the remaining preference capital of £45,000, but they do not anticipate that more than one half will be required to provide funds for the completion of the northern extension and for working capital. The accounts for the period during which the railway has been at work show that the gross receipts have been £12,352 0s. 2d., and the working expenses £6,990 5s. 2d., leaving a balance carried to net revenue account of £5,361 15s. After providing £1,623 5s. 11d. for interest on mortgage debentures from March 6th, and £122 16s. 9d. for interest on calls paid in advance, &c., the balance available for dividend amounts to £3,644 16s. 4d., out of which the directors recommend a dividend of 5 per cent. per annum upon the preference shares, which will absorb £351 7s. 4d., leaving a balance of £3,293 9s. to carry forward to next half-year.

### City and South London Railway Company.

THE directors' report for the half-year ending June 30th, 1893, to be submitted to the half-yearly ordinary general meeting of the company, to be held at Winchester House, Old Broad Street, in the City of London, on Tuesday, August 1st, 1893, reads as follows:—

"The receipts from all sources for the past half-year have amounted to £23,159 6s. 3d., and the cost of working has been £14,964 0s. 6d., leaving a profit of £8,195 5s. 9d. Inclusive of the balance brought forward from December 31st, last, the net revenue account shows an aggregate total of £9,073 12s. 10d. After making provision for the debenture and debenture stock interest, amounting to £4,110 13s. 10d., a balance remains available for dividend of £4,962 19s. Out of this sum your directors recommend the full dividend of 5 per cent. per annum be paid on the preference shares, and that a dividend at the rate of ¾ per cent. per annum be paid upon the consolidated ordinary stock, leaving a balance of £898 to be carried forward to the next account. The number of passengers conveyed during the six months ended June 30th, 1893, exclusive of season ticket holders, was 3,146,656, showing an increase over the corresponding period of the previous year of 333,494. This increased traffic has been carried with immunity from any accident whatever, and the train service has been worked with unfailing regularity. Your directors regret that the amount paid for local rates and taxes continues to show an increase. The following table shows the number of passengers, exclusive of season ticket holders, carried since the opening of the railway in each half-year:—

| Half-year ended | Number of passengers. | Receipts (including season tickets). £ | s. | d. |
|---|---|---|---|---|
| December 31st, 1890 (11 days) about | 165,000 | 1,568 | 3 | 9 |
| June 30th, 1891 ... ... ... | 2,412,343 | 19,403 | 6 | 9 |
| December 31st, 1891 ... ... | 2,749,055 | 19,798 | 16 | 6 |
| June 30th, 1892 ... ... ... | 2,813,162 | 20,931 | 4 | 2 |
| December 31st, 1892 ... ... | 3,217,602 | 22,002 | 17 | 5 |
| June 30th, 1893 ... ... ... | 3,146,656 | 22,458 | 6 | 9 |
| Total since the opening of the line | 14,503,818 | £106,162 | 15 | 4 |

The engineer certifies that the locomotives, rolling stock, generating plant, permanent way, and station buildings, have been efficiently maintained in good working condition. The new sidings at the Stockwell terminus are nearly completed, and will shortly be brought into use. The working of the traffic will be greatly facilitated by this much needed accommodation. To meet the requirements of the increasing traffic, some additional rolling stock is now in course of construction. The Bill for the extension to Islington and other purposes has passed the House of Commons, and now awaits the committee of the House of Lords, where it is unopposed. This Bill includes also the extension of time for the purchase of lands and construction of works under the Act of 1890 (Clapham extension). During the half-year £3,800 of terminable 5 per cent. debenture mortgage bonds have been paid off and replaced by 4 per cent. perpetual debenture stock. In order to provide at once some additional accommodation for passengers at the entrance to the King William Street Station, the lease of the adjoining premises in Arthur Street East has been acquired on favourable terms, and the requisite alterations will shortly be commenced.

### Crompton & Co., Limited.

THE fifth report of the directors, to be presented at the annual general meeting of the shareholders at Cannon Street Hotel, on Monday, July 31st, 1893, at three o'clock p.m., reads as follows:—

"The directors herewith present to the shareholders the fifth annual statement of accounts made up to March 31st last. From this it will be seen that although the gross profits show an increase upon the figures of the preceding year, the net results have been adversely affected by unusual and unforeseen expenditure. In January last the boilers at the Chelmsford Works suddenly gave out, and had to be replaced by others, and the year's working has had to bear a large share of the cost of this renewal and of the temporary arrangement necessitated thereby. It is highly improbable that any similar abnormal expenditure will recur in future years, but the directors feel confident the shareholders will agree with them that it is right it should be charged to the year's account, even at the cost of a reduced dividend. The orders in hand continue good, and negotiations for several important contracts are approaching completion. The net profits for the year amount to £11,953 7s. 4d., and after providing for debenture interest and payments set out in the revenue accounts, and deducting the interim dividends paid, there remains, with £98 10s. 2d. brought forward from last year, a balance available for dividend of £3,019 12s. 8d. The directors propose, after setting aside £750 as a provision for doubtful debts and contingencies, to declare a preference dividend of 2s. 6d. per share, making, with the interim dividend already paid, 6 per cent. per annum on the preference shares, to provide which the sum of £800 will be taken from the reserve fund. In accordance with the articles of association, Mr. H. H. J. W. Drummond retires from the board of directors by rotation, but offers himself for re-election. The auditors, Messrs. J. H. Duncan & Co., also offer themselves for re-election.

STATEMENT OF LIABILITIES AND ASSETS at March 31st, 1893.

CAPITAL AND LIABILITIES.

| DR. | £ | s. | d. |
|---|---|---|---|
| Authorised issue 60,000 shares at £5 ... ... ... | 300,000 | 0 | 0 |
| Ordinary shares, 8,000 issued as fully paid, £40,000; ditto 1,928 shares, £1 called, £1,928; less arrears, £276, £1,652; preference shares, 28,000 at £5, £140,000; less arrears, £4,755 = £135,245 ... | 176,897 | 0 | 0 |
| Debentures issued ... ... ... ... ... | 47,805 | 0 | 0 |
| Loan from bankers ... ... ... ... ... | 18,000 | 0 | 0 |
| Sundry creditors ... ... ... ... ... ... | 26,490 | 19 | 8 |
| Doubtful debts and contingencies account ... ... | 336 | 10 | 9 |
| Reserve fund ... ... ... ... ... ... | 2,558 | 10 | 0 |
| Revenue account balance ... ... ... ... | 3,019 | 12 | 8 |
| | £275,107 | 13 | 1 |

PROPERTY AND ASSETS.

| CR. | £ | s. | d. |
|---|---|---|---|
| Freehold property and ground rents ... ... ... | 21,254 | 3 | 4 |
| Stock-in-trade ... ... ... ... ... ... | 64,236 | 1 | 11 |
| Plant, tools, furniture, fixtures, &c. ... ... ... | 44,399 | 0 | 0 |
| Installations ... ... ... ... ... ... | 850 | 0 | 0 |
| Trade debtors ... ... ... ... ... ... | 55,149 | 14 | 10 |
| Investments in shares of other companies ... ... | 12,004 | 0 | 2 |
| Chelmsford Electric Lighting and other subsidiary companies ... ... ... ... ... ... | 29,681 | 8 | 10 |
| Cash at bankers and in office ... ... ... ... | 3,044 | 4 | 0 |
| Preliminary expenses—Suspense account ... ... | 900 | 0 | 0 |
| Patents account ... ... ... ... ... ... | 13,589 | 0 | 0 |
| Goodwill ... ... ... ... ... ... ... | 30,000 | 0 | 0 |
| | £275,107 | 13 | 1 |

PROFIT AND LOSS ACCOUNT for the year ending March 31st, 1893.

| DR. | £ | s. | d. |
|---|---|---|---|
| To Trading and office expenses, salaries, agencies, &c. | 23,788 | 9 | 10 |
| „ Repairs to buildings and plant ... ... ... | 1,104 | 3 | 11 |
| „ Depreciation of plant and machinery, patents and fixtures ... ... ... ... ... ... | 3,596 | 19 | 4 |
| „ Balance carried to revenue account ... ... | 11,953 | 7 | 4 |
| | £40,443 | 0 | 5 |

| CR. | £ | s. | d. |
|---|---|---|---|
| By Gross profit from trading account, pupils' premiums, profits and dividends on investments ... | 40,443 | 0 | 5 |
| | £40,443 | 0 | 5 |

REVENUE ACCOUNT.

| DR. | | | | £ | s. | d. |
|---|---|---|---|---|---|---|
| To Interest on debentures ... ... ... ... | | | | 2,183 | 14 | 8 |
| „ Preliminary expenses (written off)... ... ... | | | | 269 | 11 | 9 |
| „ Directors', trustees' and auditors' fees ... ... | | | | 1,245 | 0 | 8 |
| „ Interim preference dividend paid December, 1891 ... ... ... | £4,126 | 13 | 3 | | | |
| „ Interim ordinary dividend paid December, 1891 ... ... ... | 975 | 0 | 0 | | | |
| „ Income tax ... ... ... ... | 232 | 4 | 6 | | | |
| „ Balance available for present distribution ... ... ... ... | 3,019 | 12 | 8 | | | |
| | | | | 8,353 | 10 | 5 |
| | | | | £12,051 | 17 | 6 |

| CR. | £ | s. | d. |
|---|---|---|---|
| By Balance from last year ... ... ... ... | 98 | 10 | 2 |
| „ Net profit from profit and loss account ... ... | 11,953 | 7 | 4 |
| | £12,051 | 17 | 6 |

We have examined the foregoing balance-sheet, and the accounts and vouchers relating thereto, and certify it correct, subject to our report of this date.

39, Coleman Street, E.C.
*July 21st*, 1893.

J. H. DUNCAN & Co.,
*Chartered Accountants.*

## The Chili Telephone Company, Limited.

THE directors' report to March 31st, 1893, to be submitted to the shareholders at the annual general meeting to be held on August 2nd, 1893, at Winchester House, E.C., reads as follows:—

"The board submits to the shareholders its fourth annual report and accounts of the company to March 31st, 1893, duly audited. The business of the company during the past year has shown a satisfactory improvement *in dollars*, but has been less profitable *in sterling* than that of previous years. This result is due to the depreciation in the sterling value of the dollar, which has fallen from 1s. 7d. on March 31st, 1892, to 1s. 3d. on the same date this year. The income *in dollars* from subscribers and other sources for the year 1892-3 was $448,661; for the previous year, $378,830, showing an increase of $69,831. The maintenance, operating, and general expenses in Chili were, in 1891-2, $271,180; in 1892-3 $263,988, a reduction of $7,192. The increase of income having been $69,831, and the diminution of expenses $7,192, the total result was more favourable than in 1891-2 by $77,023. The outgoings in 1891-2 were 71·6 per cent. upon the gross revenue; but in 1892-3 they fell to 58·8 per cent., a reduction of nearly 13 per cent. This satisfactory increase of profit was *in dollars only*; the unfavourable rates of exchange reduced the available income *in sterling* very considerably. The net profit on working was—

| | £ |
|---|---|
| In 1892-3, at 1s. 6d. the $ ... ... ... ... | 13,850 |
| In 1891-2, at 1s. 7½d. the $ ... ... ... ... | 8,746 |
| Increase, notwithstanding the fall of 1½d. in the average value of the dollar ... ... ... | 5,104 |
| But the loss on the sterling value of the liquid assets on March 31st, comparing the same two years, was 4d. per $, and amounted to ... ... | 4,750 |
| Therefore the net increase in sterling was only ... | 354 |

The increase in the outgoings in England—including the interest on debentures—was £1,027, so that the net available sum for the year is less by £673 than in the previous year. The profits having been used for capital purposes, cannot be divided, and consequently the balance has been carried to a reserve account. As the tariff rates are paid in the paper dollar—now so seriously depreciated—the board has found it imperative to increase those rates. This has been done in some centres, and will be done in others. A reduction in the number of subscribers may therefore be expected; but the income will doubtless be maintained throughout, and probably considerably augmented, when the irritation generally created by changes of this kind may exhaust itself. It will be observed that the capital outlay for the past year is £16,701, being £2,000 less than the previous year. This sum has been expended on the completion of the construction of the new trunk lines, and the usual preparation for connecting additional subscribers with the exchanges, the latter is now the *only* kind of expenditure on capital account. The 4,000 shares offered to the proprietors were all taken by them, and have all been paid for in full. In accordance with the articles of association, Messrs. Ailsopp and Greenwood retire from the board of directors, and being eligible, offer themselves for re-election. The auditor, Mr. Thomas A. Welton, also retires, and offers himself for re-election.

## The Edison & Swan United Electric Light Company, Limited.

THE tenth annual report of the directors reads as follows:—"The directors have the pleasure of presenting to the shareholders their report and the accounts for the year ending June 30th, 1893. The business of the company has resulted in a credit balance of £86,642 5s. 1d. Of this, £20,632 19s. 5d. was distributed on March 14th last, as an interim payment on the "A" shares. The directors recommend a further distribution of £22,976 1s. 5d. on the "A" shares; and the whole of the cumulative preference on the "A" shares having now been paid, of £3,534 12s. on the "B" shares, the whole to be distributed in accordance with the provisions of Clause 87 of the articles of association. This will absorb £47,143 12s. 10d., leaving £39,498 12s. 3d., which the directors have carried to the reserve fund, in accordance with Clause 89 of the articles of association. This will make the present distribution on the ordinary "A" shares, 4s. 1d. per share; on the fully-paid "A" shares allotted to the Swan United Company, 5s. 1d. per share; on the fully-paid "A" shares allotted to the Edison Company, 6s. 8⅔d.; on the "B" shares (fully-paid), 3s.; all free of income-tax. The directors are developing the manufacturing branch of the business, and are making and supplying electrical instruments, fittings, and electrical appliances. They have reopened the factory at Newcastle, and have opened depôts for the sale of lamps and fittings in the principal towns in the provinces. Major Flood Page and Mr. Bidwell, F.R.S., retire by rotation from the board, and offer themselves for re-election. Messrs. Welton, Jones & Co, the auditors, offer themselves for re-election."

PROFIT AND LOSS ACCOUNT for the year ended June 30th, 1893.

| DR. | £ | s. | d. |
|---|---|---|---|
| To Stock on hand, July 1st, 1892 ... ... ... | 45,225 | 19 | 11 |
| „ Wages, purchases, &c. ... ... ... ... | 86,139 | 8 | 11 |
| „ Salaries, directors' remuneration, rent, office expenses, insurance, income tax, general and law charges ... ... ... ... ... | 16,265 | 18 | 9 |
| „ Depreciation on plant, &c. ... ... ... ... | 5,997 | 14 | 6 |
| „ Balance ... ... ... ... ... ... | 86,642 | 5 | 1 |
| | £240,271 | 7 | 2 |

| CR. | £ | s. | d. |
|---|---|---|---|
| By Sale of lamps, fittings, royalty on holders, &c. ... | 183,641 | 2 | 5 |
| „ Interest, &c. ... ... ... ... ... ... | 1,788 | 11 | 6 |
| „ Stock on June 30th, 1893 ... ... ... ... | 54,841 | 13 | 3 |
| | £240,271 | 7 | 2 |

BALANCE SHEET, June 30th, 1893.

| Dr. | £ | s. | d. |
|---|---|---|---|
| To Share Capital:— | | | |
| „ 5,000 "A" shares of £5 each, fully paid, allotted to the Edison Electric Light Company, Limited, £25,000; 12,139 "A" shares of £5 each, fully paid, allotted to the Swan United Electric Light Company, Limited, ranking up to 5 per cent. for dividend on the amount credited as paid up, and afterwards equally, per share, with "A" shares partly paid, £60,695; 89,261 "A" shares, £5 each, £3 paid, £267,783; 23,564 "B" shares, £5 each, fully paid, £117,820 ... ... ... | 471,298 | 0 | 0 |
| „ Sundry credit balances ... ... ... ... | 21,691 | 16 | 5 |
| „ Reserve fund ... ... ... ... ... ... | 33,262 | 0 | 11 |
| „ Profit and loss as per appropriation account, £86,642 5s. 1d.; less interim dividend, paid on March 14th, 1893, £20,632 19s. 5d. ... ... | 66,009 | 5 | 8 |
| | £592,261 | 3 | 0 |

| CR. | £ | s. | d. |
|---|---|---|---|
| By Cost of patents, goodwill, preliminary outlay, loss on working, &c., as per last balance-sheet, £236,099 0s. 11d.; further expenditure thereon, £6,145 2s. 3d., 242,244 3s. 2d.; amount of "B" shares of this company, issued as per contra, £117,820 ... ... ... ... ... ... | 360,064 | 3 | 2 |
| „ Manchester Edison-Swan Company, Limited, 100,000 "B" shares at nominal cost ... ... | 12,000 | 0 | 0 |
| „ Freehold property ... ... ... ... ... | 40,437 | 12 | 2 |
| „ Plant and stock ... ... ... ... ... | 84,926 | 2 | 8 |
| „ Debtors ... ... ... ... ... ... | 52,765 | 5 | 0 |
| „ Investment in consols at cost ... ... ... | 20,000 | 0 | 0 |
| „ Cash at bankers and in hand ... ... ... | 22,068 | 0 | 0 |
| | £592,261 | 3 | 0 |

We have examined the foregoing balance-sheet and find it to be correct and in accordance with the books and vouchers of the company.

WELTON, JONES & Co., *Auditors.*

London, *July 22nd*, 1893.

STATEMENT SHOWING THE PROPOSED APPROPRIATION OF PROFITS.

| | £ | s. | d. |
|---|---|---|---|
| To Payment of an interim dividend, as follows:—To balance of arrears of cumulative preferential dividend on the A shares, £8,261 4s. 10d.; To 3½ per cent. for the half-year ended December 31st, 1892, £12,371 14s. 7d. ... ... ... | 20,632 | 19 | 5 |
| „ 3½ per cent. for the half-year ended June 30th, 1893, £12,371 14s. 7d.; To 3 per cent. on the A and B shares for the year ended June 30th, 1893, £14,138 18s. 10d. ... ... ... ... | 26,510 | 13 | 5 |
| „ Reserve fund ... ... ... ... ... ... | 39,498 | 12 | 3 |
| | £86,642 | 5 | 1 |

| | £ | s. | d. |
|---|---|---|---|
| By Balance of profit for current year to June 30th, 1893 ... ... ... ... ... ... ... ... | 86,642 | 5 | 1 |
| | £86,642 | 5 | 1 |

## Anglo-American Telegraph Company, Limited.

THE directors' report, to be presented to the ordinary general half-yearly meeting of the proprietors, to be held at Winchester House, to-day, at 2 o'clock p.m., reads as follows:—

"The total receipts from January 1st to June 30th, 1893, including the balance of £737 3s. 9d. brought forward from the last account, amounted to £148,185 14s. 11d. This sum, however, is subject to revision, as the law-suit between this company and the Paris and New York Telegraph Company is still pending before the Court of Appeal in Paris, and will not be heard until after the Vacation. The traffic receipts show an increase of £367 as compared with the corresponding period of last year. The total expenses of the half-year, including the repair of cables, &c., as shown by the revenue account, amounted to £60,182 13s. 2d., being an increase of £818 11s. 4d. upon the corresponding period of 1892. One quarterly interim dividend of 12s. 6d. per cent. on the ordinary stock, and of £1 5s. per cent. on the preferred stock, was paid on May 1st, 1893, absorbing £43,750, and a second quarterly dividend at the same rates will be paid on August 1st, 1893, leaving a balance of £503 1s. 9d. to be carried forward to the next account. The company's repairing ss. *Minia* has been engaged during the past half-year in the following repairs, viz.:—Heart's Content and Placentia (Island Cove) cable, Placentia and Sydney (Southern) cable, St. Pierre and Duxbury cable, Brest and St. Pierre (1869) cable. Three breaks have occurred in the last-mentioned cable in deep water, one of which was repaired on June 10th, and the *Minia* is now employed in the repair of the others. The Valentia and Heart's Content cable, laid in 1874, was broken on July 9th, 575 miles from Heart's Content; the Telegraph Construction and Maintenance Company's ss. *Calabria* has been chartered for its repair. The company's other cables and land lines are in good working order and condition. The directors report with extreme regret the death of their highly esteemed colleague, Sir James Anderson, which occurred on May 7th last, and at the same time desire to record and acknowledge the valuable services he rendered to the company, not only at the time the Atlantic cables of 1865 and 1866 were laid, but during the many years he occupied a seat at this board."

## The Direct United States Cable Company, Limited.

THE directors' report for the six months ended June 30th, 1893, presented at the thirty-second ordinary general meeting of the company, to be held at Winchester House this day, at 1 p.m., reads as follows:—

"Herewith the directors submit the usual statements of account for the half-year ended June 30th, 1893, which, with the half-year's accounts to December 31st last, presented at the ordinary general meeting on January 27th last, show the financial result of the sixteenth year's working of the company. The half-year's revenue, after deducting out payments, amounted to £40,836 17s. 4d. as compared with £39,014 14s. 1d. for the corresponding period of 1892, being a difference of £1,822 3s. 3d. in favour of the half-year under review. The working and other expenses for the same period, including income tax, amounted to £18,898 5s. 7d., leaving a balance of £21,938 11s. 9d. as the net profit of the half-year, making, with £3,129 0s. 7d. brought forward from the previous half-year, a total of £25,067 12s. 4d. For the corresponding period of 1892, the working expenses and other payments amounted to £19,018 11s. 3d. Three quarterly interim dividends of 3s. 6d. each per share, amounting to £31,872 15s., have been declared and paid during the financial year, and a final payment of 3s. 6d. per share is now proposed, making, with the three interim dividends, 3½ per cent. for the year, being a total distribution of £42,497. After transferring £3,000 to the reserve fund account, which now stands at £267,415 12s. 7d., the balance of £819 2s. 4d. on the revenue account is proposed to be carried forward. The new permanent structures at Ballinskelligs, consisting of a general station building and a house for the superintendent, are now completed and occupied. Two blocks of semi-detached cottages are needed at this station to replace the dilapidated wooden houses at present occupied by the married staff, and will be provided at an estimated cost of about £2,700. A new station for the acceptance and delivery of telegrams has been opened at 142A, Winchester House, Old Broad Street, E.C. Pursuant to the provisions of the articles of association, two of the directors, viz., Charles Meara, Esq., and E. M. Underdown, Esq., Q.C., retire by rotation, and being eligible, offer themselves for re-election. Mr. John G. Griffiths, F.C.A., and Mr. John Sawyer, F.C.A., the auditors, retire pursuant to the articles of association, and offer themselves for re-election."

**Oriental Telephone and Electric Company, Limited.**—The directors have resolved to recommend, subject to final audit, a dividend for the year ending December 31st last, at the rate of 2½ per cent. on the entire paid up capital of the company, the dividend being payable only to the holders of the ordinary shares is equivalent to £3 12s. 2d. per cent. on each share of 11s. paid, the same rate as paid for the previous year.

**The Direct Spanish Telegraph Company, Limited.**—The board have decided, subject to audit, to recommend the payment of the dividend at the rate of 10 per cent. per annum on the preference shares, and a dividend at the rate of 4 per cent. per annum, free of income tax, on the ordinary shares, both for the half-year ended June 30th last.

**The Westminster Electric Supply Corporation, Limited.**—The directors have declared an interim dividend for the half-year ending June 30th last, at the rate of 3 per cent. per annum, payable on September 1st next, to all shareholders whose names are on the register on July 26th.

**The Charing Cross and Strand Electricity Supply Corporation, Limited.**—The directors on Thursday, 20th inst., decided to declare an interim dividend at the rate of £5 per cent. per annum on the ordinary shares (30,000 of £5 each), of this corporation, and same will be paid on the 15th day of August, 1893.

**Eastern Extension, Australasia and China Telegraph Company.**—The interest on the 4 per cent. mortgage debenture stock for the half-year ended July 31st inst., will be paid by warrant on August 1st next.

## TRAFFIC RECEIPTS.

**The City and South London Railway Company.** The receipts for the week ending July 23rd, 1893, amounted to £761; week ending July 24th, 1892, £788; decrease £27; total receipts for half-year, 1893, £2,603; corresponding period, 1892, £2,286; increase £317.

**The Western and Brasilian Telegraph Company, Limited.** The receipts for the week ending July 21st, after deducting 17 per cent. of the gross receipts payable to the London Platino-Brasilian Telegraph Company, Limited, were £2,337.

## SHARE LIST OF ELECTRICAL COMPANIES.

| Present Issue. | Name. | Stock or Share.‡ | Closing Quotation July 19th. | Closing Quotation, July 26th. | Business done during week ended July 26th, 1893. Highest. | Lowest. |
|---|---|---|---|---|---|---|
| 195,100*l* | African Direct Telegraph, Ltd., 4 p. c., Deb. Regd. and to Bearer | 100 | 99 —102 | 99 —102 | ... | ... |
| 1,134,640*l* | Anglo-American Telegraph, Limited ... ... ... ... ... | Stock | 50½ — 51½ | 49½ — 50½ | 49½ | 49 |
| 2,932,680*l* | Do. do. 6 p. c. Preferred ... ... ... ... ... | Stock | 94 — 95 | 93 — 94 | 95 | 93⅝ |
| 2,876,140*l* | Do. do. Deferred ... ... ... ... ... | Stock | 9½ — 10 | 9⅛ — 9⅜ | 10 | 9⅛ |
| 130,000 | Brazilian Submarine Telegraph, Limited ... ... ... ... | 10 | 11⅜ — 12½ | 11⅜ — 12⅜ | 12 1/16 | 12 |
| 36,400*l* | Do. do. 5 p. c. Bonds ... ... ... ... ... | 100 | 100 —103 | 101 —104 | ... | ... |
| 75,000*l* | Do. do. 5 p. c., 2nd Series, repayable in June, 1908 ... | 100 | 106 —110 | 107 —111 | ... | ... |
| 77,978 | Brush Electrical Engineering Ordinary, Nos. 1 to 63,416 ... ... | 3 | 2⅞ — 3⅛ | 2⅞ — 3⅛ | 3 | 2⅞ |
| 75,000 | Do. do. Non cum. 6 p. c. Preference, Nos. 1 to 63,416 | 2 | 2⅛ — 2⅜ | 2 — 2⅛ | 2⅛ | 2 1/16 |
| 125,000*l* | Do. do. 4½ per cent. Debenture Stock ... ... | Stock | 107 —109 | 107 —109 | 108½ | 108¼ |
| 20,510 | { Charing Cross & Strand Electricity Supply Nos. 1 to 6, 215 to 718, and 10,001 to 30,000 } | 5 | 5 — 5½ | 5 — 5½ | ... | ... |
| 44,000 | Chili Telephone, Limited, Nos. 1 to 40,000 ... ... ... ... | 5 | 2 — 3 | 2 — 3 | ... | ... |
| 630,000*l* | City and South London Railway ... ... ... ... | Stock | 35 — 37 | 35 — 37 | ... | ... |
| 40,000 | City of London Elec. Lighting Co., Ltd., Ord. 40,001-80,000 ... | 10 | 10⅜ — 11¼ | 10⅜ — 11¼ | 11 | 10⅜ |
| 20,000 | Do. do. 6 p. c. Cum. Pref., Nos. 1 to 20,000 | 10 | 12½ — 13 xd | 12½ — 13 xd | 12⅞ | 12 11/16 |
| $7,716,000 | Commercial Cable, Capital Stock ... ... ... ... ... | $100 | 138 —142 | 138 —142 | ... | ... |
| 224,850 | Consolidated Telephone Construction and Maintenance, Limited ... | 14/- | ¼ — ¼ | ¼ — ¼ | ... | ... |
| 20,000 | Crompton & Co., Ltd, 7 p. c. Cum. Pref. Shares, Nos. 1 to 20,000 | 5 | 5 — 5½ | 4¾ — 5¼ | ... | ... |
| 50,000*l* | { Do. do. 5 p. c. 1st Mort. Debs., 1—400 of £100, and "A" 1—200 of £50 each } | ... | ... ... | 102 —105 | ... | ... |
| 16,000 | Cuba Telegraph, Limited ... ... ... ... ... ... | 10 | 11½ — 12½ | 11½ — 12½ | ... | ... |
| 6,000 | Do. do. 10 p. c. Preference ... ... ... ... | 10 | 18½ — 19½ | 18½ — 19½ | ... | ... |
| 12,931 | Direct Spanish Telegraph, Limited, ... ... (£4 only paid) | 5 | 2½ — 3½ | 2½ — 3½ | ... | ... |
| 6,000 | Do. do. 10 p. c. Preference ... ... ... | 5 | 9 — 10 | 9 — 10 | ... | ... |
| 60,710 | Direct United States Cable, Limited, 1877 ... ... ... ... | 20 | 11⅞ — 12⅛ | 11⅞ — 12 | 12 | 11⅝ |
| 400,000 | Eastern Telegraph, Limited, Nos. 1 to 400,000 ... ... ... | 10 | 15 — 15¼ | 15 — 15¼ | 15¼ | 15 |
| 70,000 | Do. 6 p. c. Preference ... ... ... ... | 10 | 16½ — 17 | 16½ — 17 | 16 15/16 | 16 9/16 |
| 105,900*l* | Do. 5 p. c. Debs. (1879 issue), repay. August, 1899 | 100 | 108 —111 | 108 —111 | ... | ... |
| 1,294,100*l* | Do. 4 p. c. Mortgage Debenture Stock ... ... | Stock | 112 —115 | 112 —115 | 114 | 113½ |
| 250,000 | Eastern Extension, Australasia and China Telegraph, Limited ... | 10 | 15½ — 15⅞xd | 15½ — 15⅝ | 15⅞ | 15⅝ |
| 70,600*l* | { Do. 5 p. c. (Aus. Gov. Sub.), Deb., 1900, red. ann. drgs. reg. 1 to 1,049, 3,976 to 4,326 } | 100 | 102 —105 | 102 —105 | 103 | ... |
| 250,200*l* | Do. do. Bearer Nos. 1050—3,975 and 4,327—6,400 ... | 100 | 102 —105 | 102 —105 | 104 | 103½ |
| 320,000*l* | Do. 4 p. c. Debenture Stock ... ... ... ... ... | Stock | 113 —116 | 113 —116 | 113½ | ... |
| 108,700*l* | { Eastern and South African Telegraph, Ltd., 5 p. c. Mort. Deb. 1900 redeem. ann. drawings, Registered Nos. 1 to 2,343 } | 100 | 101 —104 | 101 —104 | ... | ... |
| 146,800*l* | Do. do. do. to bearer, Nos. 2,344 to 5,500 | ... | 101 —104 | 101 —104 | 101½ | ... |
| 300,000*l* | Do. do. 4 p. c. Mort. Debs. Nos. 1 to 2016, red. 1909 | 100 | 102 —105 | 102 —105 | ... | ... |
| 49,900 | Electric Construction, Limited, Nos. 101 to 45,100 ... ... ... | 10 | 1⅞ — 2¼ | 1⅞ — 2¼ | 2 | 1⅞ |
| 19,900 | *Electricity Supply Co. of Spain, Nos. 101 to 20,000 ... ... ... | 5 | ... ... | ... ... | ... | ... |
| 100,000 | Elmore's French Patent Copper Depositing Co., Ltd, Nos. 1 to 66,750 | 2 | ⅛ — ¼ | ⅛ — ¼ | ... | ... |
| 91,195 | Elmore's Patent Copper Depositing, Limited., Nos. 1 to 70,000 ... | 2 | ¼ — ⅜ | ¼ — ⅜ | ... | ... |
| 67,385 | Elmore's Wire Mfg., Ltd., Nos. 1 to 67,385, issued at 1 p.m., all pd. | 2 | ⅜ — ⅝ | ⅜ — ⅝ | ... | ... |
| 20,000 | Fowler-Waring Cables, Nos. 301 to 20,300 ... (£4 10s. only paid) | 5 | 1 — 2 | 1 — 2 | 1¼ | 1 1/16 |
| 180,227 | Globe Telegraph and Trust, Limited ... ... ... ... ... | 10 | 9⅜ — 10 | 9⅜ — 10 | 10 | 9⅜ |
| 180,042 | Do. do. 6 p. c. Preference ... ... ... | 10 | 15⅝ — 15⅞ | 15½ — 15¾ | 15⅞ | 15½ |
| 150,000 | Great Northern Tel. Company of Copenhagen ... ... ... | 10 | 19½ — 20 | 19½ — 20 | 20 | ... |
| 200,000*l* | Do. do. 5 p. c. Debs. (issue of 1883) ... | 100 | 105 —108 | 105 —108 | 107½ | ... |
| 12,134*l* | Greenwood and Batley, Ltd., Ordinary, Nos. 4667 to 14,000 ... | 10 | 4½ — 5½ | 4½ — 5½ | ... | ... |
| 9,600*l* | Do. 7 p. c. Cumulative Preference, Nos. 2,667 to 8,000 | 10 | 6 — 7 | 6 — 7 | ... | ... |
| 50,000 | India-Rubber, Gutta Percha and Telegraph Works, Limited .. | 10 | 22 — 23 xd | 21½ — 22½ | 22⅝ | 22 |
| 200,000*l* | Do. do. 4½ p. c., Deb., 1896 ... ... ... | 100 | 102 —104 | 102 —104 | 103½ | ... |
| 17,000 | Indo-European Telegraph, Limited ... ... ... ... | 25 | 39 — 42 | 39 — 42 | 39½ | ... |
| 11,334 | International Okonite, Ltd., Ordinary Nos. 22,667 to 34,000 ... ... | 10 | 2½ — 3½ | 2½ — 3½ | ... | ... |
| 30,000 | †Liverpool Electric Supply, £3 10s. paid ... ... ... ... | 5 | 4 5/16 — 4 7/16 | 4 5/16 — 4 7/16 | ... | ... |
| 10,000 | Do. do. fully paid ... ... ... ... | 5 | 6⅜ — 6⅝ | 6⅜ — 6⅝ | ... | ... |
| 37,548 | London Platino-Brasilian Telegraph, Limited ... .. ... | 10 | 4 — 6 | 4 — 6 | ... | ... |
| 100,000*l* | Do. do. do. 6 p. c. Debentures ... ... | 100 | 107 —110 | 107 —110 | ... | .. |
| 49,900 | *Metropolitan Electric Supply, Ltd., Nos. 6,101 to 50,000 (£9 paid) | 10 | 6 — 6½ | 6 — 6½ | 6½ | ... |
| 50,000*l* | Do. 5 p.c. debentures, 1 to 5,000 in bonds of £10, £20, £40 | ... | 102 —105 | 102 —105 | 102 | ... |
| 15,000 | Monte Video Telephone Co., Ord., Nos. 1 to 15,000 fully paid ... | 5 | 1⅜ — 2½ | 1⅜ — 2½ | ... | ... |
| 28,000 | Do. do. 6 p. c. Pref., Nos. 1 to 28,000 fully paid | 5 | 3 — 4 | 3 — 4 | ... | ... |
| 458,867 | National Telephone, Limited, Nos. 1. to 438,984 ... ... ... | 5 | 4⅜ — 5 | 4⅜ — 4⅞ | 5 | 4 11/16 |
| 15,000 | Do. 6 p. c. Cum., 1st Preference ... ... ... | 10 | 14⅜ — 15½ | 14⅜ — 15½ | 15½ | ... |
| 15,000 | Do. 6. p. c. Cum. 2nd Preference ... ... ... | 10 | 14½ — 14⅝ | 14½ — 14⅝ | ... | ... |
| 90,950 | Do. 5 p. c. Non-cum. 3rd Pref., Nos. 1 to 90,950 ... | 5 | 5⅜ — 5⅝ | 5⅜ — 5⅝ | 5⅝ | 5 7/16 |
| 726,477*l* | Do. 4½ p.c. Deb. Stock Prov. Certs. fully paid ... | ... | 110 —115 | 110 —114 | 113½ | 112¾ |
| 48,800*l* | New Telephone, Limited, Nos. 25,901 to 74,700 ... (£2 paid) | 10 | ... ... | ... ... | ... | ... |
| 6,451 | Notting Hill Electric Lighting Company, Limited, fully paid ... | 10 | 5 — 6 | 5 — 6 | ... | ... |
| 220,000 | Oriental Telephone, Ltd., Nos. 80,001 to 300,000 (11s. only paid) | 1 | ⅛ — ¼ | ⅛ — ¼ | ... | ... |
| 100,000*l* | Pacific and European Tel., Ltd., 4 p. c. Guar. Debs., Nos. 1 to 1,000 | 100 | 100 —103 | 100 —103 | ... | ... |
| 11,802 | Reuter's Limited ... ... ... ... ... ... ... ... | 8 | 5 — 6 | 4½ — 5½ | 4½ | ... |
| 18,680 | St. James's & Pall Mall Electric Light Co., Ltd., Ord., 101—18,780 | 5 | 7 — 7½ | 6½ — 7 | 6¾ | ... |
| 20,000 | Do. do. 7 per cent. pref., Nos. 20,081 to 40,080 | 5 | 8 — 8½ | 8 — 8½ | 8 | ... |
| 3,381 | Submarine Cables Trust ... ... ... ... ... ... | Cert. | 119 —124 | 118 —123 | 122 | ... |
| 78,949 | Swan United Electric Light, Limited ... ... (£3½ only paid) | 5 | 1⅞ — 2¼ | 2 — 2½ | 2 7/16 | 2⅜ |
| 37,350 | Telegraph Construction and Maintenance, Limited ... .. ... | 12 | 33 — 35 | 33 — 35 | 34½ | 34⅜ |
| 150,000*l* | Do do. do. 5 p. c. Bonds, red. 1894 | 100 | 101 —104 | 101 —104 | ... | ... |
| 58,000 | United River Plate Telephone, Limited ... ... ... ... | 5 | 2 — 2½ | 2 — 2½ | ... | ... |
| 146,370*l* | Do. do. 5 p. c. Debenture Stock ... | Stock | 99 —102 | 90 — 100 | ... | ... |
| 15,609 | West African Telegraph, Limited, Nos. 7,501 to 23,109 ... ... | 10 | 5½ — 6½ | 5½ — 6½ | ... | ... |
| 260,900*l* | Do. do. do. 5 p. c. Debentures ... .. | 100 | 99 —102 | 99 —102 | 99 | ... |
| 30,000 | West Coast of America Telegraph, Limited ... ... ... ... | 10 | 3 — 4 | 3 — 4 | ... | ... |
| 150,000*l* | Do. do. do. 8 p. c. Debs., repayable 1902 ... | 100 | 97 —101 | 97 —101 | ... | ... |
| 64,242 | Western and Brazilian Telegraph, Limited ... ... ... ... | 15 | 7¼ — 7⅝ | 7 — 7½ | 7¼ | 7 |
| 33,129 | Do. do. do. 5 p. c. Cum. Preferred ... ... | 7½ | 5⅞ — 6¼ | 5⅞ — 6¼ | ... | ... |
| 33,129 | Do. do. do. 5 p. c. Deferred ... ... ... | 7½ | 1½ — 2 | 1½ — 2 | 1⅝ | 1 9/16 |
| 178,200*l* | Do. do. do. 6 p. c. Debentures "A," 1910 ... | 100 | 106 —109 | 106 —109 | ... | ... |
| 222,700*l* | Do. 6 p. c. Mort. Debs., series "B" of '80, red. Feb., 1910 | 100 | 106 —109 | 106 —109 | ... | .. |
| 88,321 | West India and Panama Telegraph, Limited ... ... ... | 10 | 1½ — 1⅝ | 1½ — 1⅝ | ... | ... |
| 34,563 | Do. do. do. 6 p. c. 1st Preference ... | 10 | 10½ — 11 | 10½ — 11 | 10⅝ | 10½ |
| 4,669 | Do. do do. 6 p. c. 2nd Preference ... | 10 | 9½ — 10½ | 9 —10 | ... | ... |
| 80,000*l* | Do. do. 5 per cent debentures (1917) No. 1 to 1,000 | 100 | 105 —108 | 105 —108 | ... | ... |
| $1,214,000 | Western Union of U.S. Tel., 7 p. c. 1st Mortgage (Building) Bonds | $1,000 | 120 —125 | 120 —125 | ... | ... |
| 169,000*l* | Do. do. 6 p. c. Sterling Bonds ... ... ... | 100 | 100 —103 | 100 —103 | ... | ... |
| 69,900 | *Westminster Electric Supply Corp., Ord., Nos. 101 to 42,953 ... | 5 | 5¼ — 5⅜ | 5¼ — 5⅜ | 5¼ | ... |

* Subject to Founders' Shares. † Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid.

**LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED:**—Birmingham Electric Supply Company, Ordinary of £5 (fully paid), 5⅜—6.—Brush Company 4½ per cent. Debenture stock, issued at 1 per cent. premium, 100—103.—Electric and General Investment, shares of £5 (£1 paid), 1½—2½.—Founders' shares, 200—225.—Electric Construction Corporation, 6 per cent. Debentures, 95—98.—Electricity Supply Corporation, Ordinary of £5, 5—5½.—House to House Company (£5 paid) 1½—2½.—Do. 7 per cent. Preference of £5, 5—5½.—Do. 6 per cent. Debentures of £100, 97—102.—Kensington and Knightsbridge Electric Lighting Company, Limited, Ordinary Shares £5 (fully paid), 5¼—5⅝, 1st Preference Cumulative 6 per cent., £5 (fully paid 6—6¼.—Manchester Edison and Swan Company, £9 (£1 paid), ⅛—¼.—Queen Anne's Mansions Lighting and Heating 6 per cent. £10 Debentures 101—102.

Bank rate of discount, 2½ per cent (June 15th, 1893).

## THE FORD-WASHBURN STORAGE CELL.*

PROFS. JOHN W. LANGLEY AND CHAS. T. MABERY have recently made an exhaustive and elaborate report on the Ford-Washburn storage cell (described in the *Electrical World*, July 30th, 1892), in which its electrical, chemical, and mechanical properties are thoroughly considered. As a result of the tests the following conclusions are given :—

1. The cells have not appreciably changed their internal resistance during two months' constant use, when tested under similar conditions.

2. Vibration and shaking, continued for an aggregate of 422 hours, did not increase the internal resistance.

3. The ampère capacity of the cells is 150 hours when tested to exhaustion, and when drawn down to 1 volt a cell holds 133 ampère-hours at a 10-ampère rate of discharge.

4. The practical working limits of voltage are from 2 volts to 1 volt.

5. The cells do not show any marked tendency to "sulphating," and their internal resistance is not permanently raised thereby.

6. During the interval covered by this report neither large rates of charging and discharging nor a prolonged course of vibration, imitating that of a street car, produces any measurable deterioration of plates. In this respect the Ford-Washburn cell was in marked contrast to a cell of the grid type used for comparison.

7. The ampère efficiency varied from 73 to 86 per cent., and the energy efficiency from 55 to 72 per cent.

8. The electrical and mechanical hard treatment to which the cells were subjected in their hands was excessive, and indicates that they have the qualities to withstand rough usage in practice, for, from the results given above, it is apparent that no measurable impairment of them was developed by exceptionally severe electrical and mechanical usage during two months ; therefore, the point when the life of the cells would be terminated is indefinitely distant in the future.

## RUBBER COMPOUNDS v. VULCANISED RUBBER AS A CABLE DIELECTRIC.

ON one point English engineers may well be congratulated with respect to existing practice in electrical work generally. The use of vulcanised rubber as an insulator is nowhere a matter of such general and widespread acceptance as it is in this country, despite the costliness which this entails. The climatic conditions, coupled with what, without boastfulness, may be termed British thoroughness, have long ago taught those who cared to learn, that for house work, at least, a first-class insulator possessing highly waterproof qualties was the only material with which to cover conductors and hope for success. The only exception to this recognised general rule is in the case of underground networks where the firm of Siemens have utilised impregnated fibre with considerable success. In America we have all heard they are not so fastidious in their tastes, and nature does not hit them quite so hard if they err a little as she would smite us. Jupiter Pluvius is the greatest enemy of those who would have us patrons of what a well-known and much respected central station manager recently called "messes and messy coverings."

Amongst other qualities which the Americans are fond of claiming for certain classes of dielectrics is that dubbed "fire-proofness." This term is always regarded as a sure sign of merit, and its use is so general that it is well nigh a certainty to find any new brand heralded as "perfectly fireproof."

The "Salamander" electric wires have been heard of in this country as a make of some repute in the States. We believe that an attempt has been made to bring over the "Salamander" cables and give them a local habitation. This is a matter which has more than one aspect. In the first place we should have to consider the technical perfectness, or otherwise, of these cables, in the second whether they are suited to the English market, and, thirdly, the probability of their fulfilling an existing demand for such goods or of creating one on their own account.

It may be said that there is no field for an insulating material which does not compete in price with vulcanised rubber. It is self-evident that impregnated fibre and bitumen hold fields of their own, while the advantages and acknowledged merit of vulcanised rubber are such that on commercial grounds alone would competition be justified.

Admitting for the nonce that the "Salamander" compound is one capable of resisting fairly high and continued temperatures, we would ask, wherein does this quality give such cables a superiority, or even an equality, with those of well-known and reputable home manufactures? Surely we do not want to run our cables at such high densities as to preclude the use of old and tried materials? Indeed, we we may go further, and say that at first sight there does not appear to be one single instance which such cables could serve where existing dielectrics would not equally well meet the case.

We may shortly give a description of an experiment which has conclusively proved that for 1,000 ampères density on average underground cables the maximum rise in temperature does not exceed the Board of Trade limit of 30° F.

The action of a short-circuit has been fully exemplified in the past, and the arc has shown what it can do against what are usually regarded as fireproof materials. What we want is a material which, when used as a dielectric, shall, by its durability as a waterproof and insulating material, prevent incipient leakage which would give rise to increase of temperature and subsequent charring. Of course we admit that vulcanised rubber is a special rubber compound, but what can be claimed for it is a chemical stability and mechanical adaptability lacking in most of the suggested substitutes.

Insulation in practical work, mechanical strength and high resistance to disruptive discharge, coupled with the qualities mentioned, are the main requisites of a good cable. In the case of the Salamander wires we have some particulars given and have seen a sample, but most attention is drawn to the fire resisting properties claimed. The Washburn Company—the American makers—claim to have had a longer experience in the manfacture of wire for electrical purposes than any other concern in the world. This is surprising, but is it really so?

If fuses were not in regular use in this country some reason would exist for adoption of a fireproof wire, but with our work-a-day knowledge such a suggestion savours of the ridiculous. As to the tests to which the wire has been subjected, it will be remembered that some time ago we gave particulars of the trials of lengths of Salamander wire in series with similar lengths of other kinds, the whole being subjected to intense heat for a short time by passing heavy currents through the conductors. In one test the conductor was 14 B and S, and the current 140 ampères, in another similar coppers and current 155 ampères. The method of making the test is open to criticism, for it is well known that the insulation of covered conductors helps to lower the temperature of the copper in such a test. In one of the experiments a Silvertown, Glover, lead-covered, and Salamander sample were respectively connected in series. So far as could be seen from the results, the latter was by far the greatest in diameter, and would therefore be maintained at the lowest temperature. The lead-covered sample with moderately clean lead surface was in a most unfavourable condition compared with the high emissivity of the other samples.

While pointing out what we consider to be the possible partiality of the test as submitted, it is quite easy to see how such a practical test could be made of value. The suggestion that a series of experiments with identically similar samples should be made, each test being taken with the same total dissipation of energy as its neighbours, but ranging from a medium current with long application to high ampères of short duration, if carried out would remove the doubt which pertains to the solitary example alluded to. The statement that a No. 12 Salamander wire with 30 amperes flowing through it has 2 per cent. higher conductivity than that of other makes, bears out what was said above as

* New York *Electrical World*.

to the emissivity of such a large dielectric core, otherwise it is hard to see how any such 2 per cent. could be claimed.

It is also stated that the wire has been subjected to 15,000 volts without deterioration, but no details are given to enable us to judge as to the thoroughness of this test. Potential stress tests are only of value when every detail is noted and submitted, with the voltage and the time for which it was applied. There is always a good deal of scepticism as to the real stress on dielectrics having ever reached such fancy figures as 15,000 volts. Something more is needed than mere assertion that the cables withstood such a high voltage, as it is very easy to vastly overestimate the tension actually on a cable which possesses capacity and is coupled to an alternator having high self-induction, the volts being taken by coil instruments or spark gaps.

An insulation test is given in which a 210 feet length gave 4,400 megohm miles at 55° F., with 180 secs. electrification on 550 volts. No information is given as to immersion, if any, or time of same.

Without any wish to condemn a good thing, the Salamander cables do not seem likely to recommend themselves to English buyers, owing to the lack of any direct advantage accruing from their use. The insulation and disruptive results are good, but not by any means novel to users of cable in central station work. On other grounds it is difficult to see wherein such American products possess features which would ensure their obtaining a reasonable patronage, although if price were rationally arranged, no doubt purchasers would not be wanting, as the cables seem passable in themselves.

From the financial and stockbroker's point of view it is unfortunately impossible to find even so much excuse for another cable manufacturing concern. Existing firms are quite capable of coping with all the work likely to be carried out for a long time to come, and the more recent newcomers in the field—to wit, the Okonite Company and the British Insulated Wire Company—have not yet found their rubber preparation and oiled paper patents the gold mines they were formerly represented and fondly hoped to be. These companies are similar importations from the United States, where, from all we hear, the parent firms meet with a ready market.

It does not follow that we in England will gladly jump at the chance of purchasing what our brethren in the States have found suitable for their purposes, under very different climatic and other conditions. A protest from some influential quarter is badly wanted to check the imprudent promotion of undertakings to handle foreign patents and goods of a nature such as these, for the market is burdened to such an extent that those already in possession have enough to do to keep alive with all the work going on that there is. A word of caution, however, need not be taken as direct discouragement.

## A SENSATION IN ELECTRIC HEATING.*

By JULES NEHER.

In the issue of the *Electrical World* of June 10th, 1893, an interesting account of a new process for electric heating and welding was given. The experiment is based on the quality of an iron cathode, heating up very rapidly in a cell, whose electrolyte is acidulated water, and whose anode consists of a leaden cylinder, a current of about 200 ampères at 120 volts passing through. I have experimented on the same subject in the laboratories of the Westinghouse Electric and Manufacturing Company, and would like to add a few words to this article. The experiments lead me toward a somewhat different explanation of the heating effect. In the article referred to, the resistance of the hydrogen coating generated around the iron is alone said to produce the speedy heating of the iron cathode. In one of my experiments I sent 300 ampères at 125 volts through this cell without obtaining any considerable heating of the iron, the total energy being consumed by the electrolysis of the water and the heating of the electrolyte. This was the case when the iron cathode was immersed before the current switch was closed, so that the hydrogen coating was present, but practically effected no heating.

By closing the switch before immersing the iron the whole experiment is changed; the moment the iron touches the water surface, the amount of hydrogen generated separates the liquid from the metal, and an arc is drawn. The luminous effect of this arc drawn under water is most brilliant and especially striking when insulated wire is used instead of the bare iron rod, thus producing an arc in one point only, and wholly under the surface of the water.

The apparatus used had about the following dimensions: A plain glass jar, 8 inches high and 5 inches in diameter, was filled with water containing 25 per cent. sulphuric acid. The positive pole consisted of a $\frac{1}{8}$ inch sheet lead cylinder, the edges standing apart about 2 inches, so as to allow the inside of the cell to be seen. The iron cathode consisted of a $\frac{3}{8}$ inch round iron bar connected to the dynamo cable and fastened to a wooden stick. Several tests gave results as follows:—With 20 ampères at 150 volts a weight of 15 grammes of wrought-iron was brought to a melting heat in 15 seconds, the iron actually dropping down to the bottom of the jar, which was covered by a disc of lead so as to protect the glass from the hot iron.

The approximate efficiency can be calculated as follows: An amount of heat, $H_1$, is consumed in the iron; an amount of heat, $H_2$, is consumed in the water, and an amount, $H_3$, is lost by radiation and conduction; a certain amount of energy (E) is further consumed in the electrolysis of the water. In 15 seconds the temperature of 15 grammes of iron was raised about 2,000° C., and 1,500 grammes of water 3° C. This

$$\text{gives } H_1 = \frac{2{,}000^\circ \times 15 \text{ grammes} \times 0{\cdot}1138}{15 \text{ seconds}} = 250 \text{ gr. cal.} = 1{,}048 \text{ watts.}$$

0·1138 being the specific heat of the iron.

$$H_2 = \frac{3^\circ \times 1{,}500 \text{ grammes} \times 1}{15 \text{ seconds.}} = 300 \text{ gr. cal.} = 1{,}257 \text{ watts.}$$

E (consumed for the electrolysis) = 20 ampères × 1·5 volts = 30 watts (assuming 1·5 volts to be the counter E.M.F. of the cell). Total watts = 2,335.

The total available energy being 20 ampères × 150 volts = 3,000 watts, we still have 665 watts, equal to 159 gr. cal., to dispose of for $H_3$, which is about equal to 29 per cent. of $H_1 + H_2$, the total utilised heat.

The efficiency is thus found to be approximately 35 per cent., as 1,048 of the 3,000 watts are utilised in heating the iron. These calculations cannot certainly be considered exact, but are about as near as possible in this case.

Other metals, as copper and lead, are heated and melted quicker or slower, according to their conductivity for heat. Carbon is heated in a very short time, but the melting off of amorphous carbon could not be obtained, and this phenomenon is seriously doubted by the writer.

The heating by the arc under water is evidently an advantage over the heating in the atmosphere only because of the thorough heat-insulating quality of the hydrogen coating obtained around the iron, and because of the combustion of this gas at the surface of the liquid. The hydrogen actually burns in leaving the water electrolyte and a part of this heat is conveyed into the iron. Taking this additional heat into consideration, the efficiency of the process is still lowered, but at the same time the whole energy proves to be made better use of, the product of the electrolysis being utilised again for the heating purpose.

Using a low E.M.F., 100 volts for instance, the heating is scarcely perceptible, although the current is about the same, probably because of the gas coating being thinner and the arc not long enough; 125 volts seem to be the critical voltage.

By changing the poles we obtain oxygen on the iron cathode, which forms explosions in combination with the hydrogen chemically developed by the contact of iron and sulphuric acid. In this case the heating of the iron is again very low, probably because the amount of oxygen is only half the amount of the hydrogen disengaged in the reversed case, the gas coating not being thick enough to produce an effective arc, as was the case with the lower voltage.

The practical advantage of the process is undoubtedly in the total absence of oxidation of the heated metal, and this

* New York *Electrical World*.

feature might probably lead to an extensive use of the process. For the experimenter the phenomenon of wrought-iron melted like wax in a glass jar filled with water is one of the most striking.

## ON LIGHT AND OTHER HIGH FREQUENCY PHENOMENA.*

BY NIKOLA TESLA.

(*Continued from page* 83.)

If a wire or filament be immersed in a homogeneous medium, all the heating is due to true conduction current, but if it be enclosed in an exhausted vessel the conditions are entirely different. Here the gas begins to act, and the heating effect of the conduction current, as is shown in many experiments, may be very small compared with that of the bombardment. This is especially the case if the circuit is not closed and the potentials of course very high. Suppose a fine filament enclosed in an exhausted vessel be connected with one of its ends to the terminal of a high tension coil and with its other end to a large insulated plate. Though the circuit is not closed, the filament, as I have before shown, is brought to incandescence. If the frequency and potential be comparatively low, the filament is heated by the current passing *through* it. If the frequency and potential, and principally the latter, be increased, the insulated plate need be but very small, or may be done away with entirely; still the filament will become incandescent, practically all the heating being then due to the bombardment. A practical way of combining both the effects of conduction current and bombardment is illustrated in fig. 24, in which an ordinary lamp is

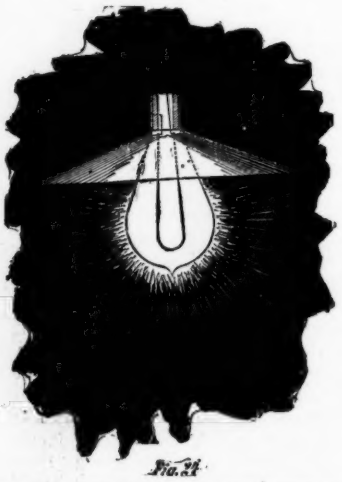

FIG. 24.

UTILISING THE HEATING EFFECT OF CONDUCTION CURRENT AND BOMBARDMENT.

shown, provided with a very thin filament, which has one of the ends of the latter connected to a shade serving the purpose of the insulated plate, and the other end to the terminal of a high tension source. It should not be thought that only rarefied gas is an important factor in the heating of a conductor by varying currents, but gas at ordinary pressure may become important, if the potential difference and frequency of the currents is excessive. On this subject I have already stated, that when a conductor is fused by a stroke of lightning, the current through it may be exceedingly small, not even sufficient to heat the conductor perceptibly, were the latter immersed in a homogeneous medium.

From the preceding it is clear that when a conductor of high resistance is connected to the terminals of a source of high-frequency currents of high potential, there may occur considerable dissipation of energy, principally on the ends of the conductor, in consequence of the action of the gas surrounding the conductor. Owing to this, the current, through a section of the conductor at a point midway between its ends, may be much smaller than through a section near the ends. Furthermore, the current passes principally through the outer portions of the conductor; but this effect is to be distinguished from the skin effect as ordinarily interpreted, for the latter would or should occur also in a continuous incompressible medium. If a great many incandescent lamps are connected in series to a source of such currents, the lamps at the ends may burn brightly, whereas those in the middle may remain entirely dark. This is due principally to bombardment, as before stated. But even if the currents be steady, provided the difference of potential is very great, the lamps at the ends will burn more brightly than those in the middle. In such case there is no rhythmical bombardment, and the result is produced entirely by leakage. This leakage or dissipation into space, when the tension is high, is considerable when incandescent lamps are used, and still more considerable with arcs, for the latter act like flames. Generally, of course, the dissipation is much smaller with steady than with varying currents.

I have contrived an experiment which illustrates in an interesting manner the effect of lateral diffusion. If a very long tube is attached to the terminal of a high-frequency coil, the luminosity is greatest near the terminal, and falls off gradually towards the remote end. This is more marked if the tube is narrow.

A small tube about ½ inch in diameter, and 12 inches long, fig. 25, has one of its ends drawn out into a fine fibre, *f*, nearly 3 feet long. The tube is placed in a brass socket, T, which can be screwed on the terminal, $T_1$, of the induction coil. The discharge passing through the tube first, illuminates the bottom of the same, which is of comparatively large section; but through the long glass fibre the discharge cannot pass. But gradually the rarefied gas inside becomes warmed and more conducting, and the discharge spreads into the glass fibre. This spreading is so slow, that it may take half a minute or more until the discharge has worked through up to the top of the glass fibre, then presenting the appearance of a strongly luminous thin thread. By adjusting the potential at the terminal, the light may be made to travel upwards at any speed. Once, however, the glass fibre is heated, the discharge breaks through its entire length instantly. The interesting point to be noted is that, the higher the frequency of the currents, or in other words, the greater relatively the lateral dissipation, at a slower rate may the light be made to propagate through the fibre. This experiment is best performed with a highly exhausted and freshly made tube. When the tube has been used for some time, the experiment often fails. It is possible that the gradual and slow impairment of the vacuum is the cause. This slow propagation of the discharge through a very narrow glass tube corresponds exactly to the propagation of heat through a bar warmed at one end. The quicker the heat is carried away laterally, the longer time it will take for the heat to warm the remote end. When the current of a low frequency coil is passed through the fibre from end to end, then the lateral dissipation is small, and the discharge instantly breaks through almost without exception.

After these experiments and observations, which have shown the importance of the discontinuity or atomic structure of the medium, and which will serve to explain, in a measure, at least, the nature of the four kinds of light effects produceable with these currents, I may now give you an illustration of these effects. For the sake of interest, I may do this in a manner which, to many of you, might be novel. You have seen before that we may now convey the electric vibration to a body by means of a single wire or conductor of any kind. Since the human frame is conducting, I may convey the vibration through my body.

First, as in some previous experiments. I connect my body with one of the terminals of a high tension transformer, and take in my hand an exhausted bulb, which contains a small carbon button mounted upon a platinum wire, leading to the outside of the bulb, and the button is rendered incandescent as soon as the transformer is set to work (fig. 26). I may place a conducting shade on the bulb, which serves to intensify the action, but is not necessary. Nor is it required that the button should be in conducting connection with the hand through a wire leading through the glass, for sufficient energy may be transmitted through the glass itself by inductive action to render the button incandescent.

Next I take a highly exhausted bulb containing a strongly phosphorescent body, above which is mounted a small plate of aluminium on a platinum wire leading to the outside, and the currents flowing through my body excite intense phosphorescence in the bulb, fig. 27. Next again I take in my hand a simple exhausted tube, and in the same manner the gas inside the tube is rendered highly incandescent or phosphorescent, fig. 28. Finally, I may take in my hand a wire, bare, or covered with thick insulation, it is quite immaterial; the electric vibration is so intense, as to cover the wire with a luminous film, fig. 29.

A few words must now be devoted to each of these phenomena. In the first place, I will consider the incandescence of a button or of a solid in general, and dwell upon some facts which apply equally to all these phenomena. It was pointed out before that when a thin conductor, such as a lamp filament, for instance, is connected with one of its ends to the terminal of a transformer of high tension the filament is brought to incandescence partly by a conduction current and partly by bombardment. The shorter and thicker the filament the more important becomes the latter and finally, reducing the filament to a mere button, all the heating must practically be attributed to the bombardment. So in the experiment before shown, the button is rendered incandescent by the rhythmical impact of freely movable small bodies in the bulb. These bodies may be the molecules of the residual gas, particles of dust or lumps torn from the electrode; whatever they are, it is certain that the heating of the button is essentially connected with the pressure of such freely movable particles, or of atomic matter in general in the bulb. The heating is the more intense the greater the number of impacts per second and the greater the energy of each impact. Yet the button would be heated also if it were connected to a source of a steady potential. In such a case electricity would be carried away from the button by the freely movable carriers or particles flying about, and the quantity of electricity thus carried away might be sufficient to bring the button to incandescence by its passage through the latter. But the bombardment could not be of great importance in such case. For this reason it would require a comparatively very great supply of energy to the button to maintain it at incandescence with a steady potential. The higher the frequency of the electric

* A lecture delivered before the Franklin Institute, at Philadelphia, February 24th, 1893, and before the National Electric Light Association, at St. Louis, Mo., March 1st, 1893.

impulses the more economically can the button be maintained at incandescence. One of the chief reasons why this is so, is, I believe, that with impulses of very high frequency there is less exchange of the freely movable carriers around the electrode, and this means, that in the bulb the heated matter is better confined to the neighbourhood of the button. If a double bulb, as illustrated in fig. 30,

Fig. 25.

ILLUSTRATING FOUR KINDS OF LIGHT EFFECTS PRODUCED BY HIGH FREQUENCY CURRENTS OF HIGH POTENTIAL.

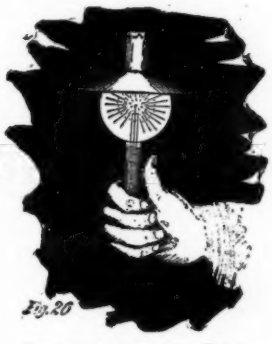

Fig. 20.

ILLUSTRATING LATERAL DIFFUSION. INCANDESCENCE OF A SOLID.

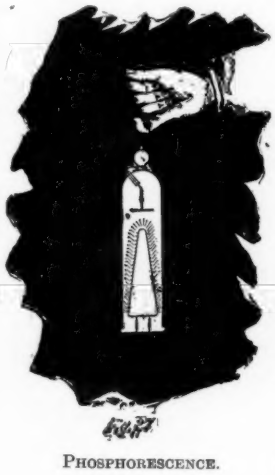

Fig. 27.

Fig. 22.

PHOSPHORESCENCE. INCANDESCENCE OR PHOSPHORESCENCE OF RAREFIED GAS.

Fig. 29.

LUMINOSITY OF GAS AT ORDINARY PRESSURE.

be made, comprising a large globe, B, and a small one, $b$, each containing as usual a filament, $f$, mounted on a platinum wire, $w$ and $w_1$, it is found that if the filaments, $f, f$, be exactly alike, it requires less energy to keep the filament in the globe, $b$, at a certain degree of incandescence, than that in the large globe, B. This is due to the confinement of the movable particles around the button. In this case it is also ascertained that the filament in the small globe, $b$, is less deteriorated when maintained a certain length of time at incandescence. This is a necessary consequence of the fact that the gas in the small bulb becomes strongly heated and therefore a very good conductor, and less work is then performed on the button, since the bombardment becomes less intense as the conductivity of the gas increases. In this construction, of course, the small bulb becomes very hot, and when it reaches an elevated temperature the convection and radiation on the outside increase. On another occasion I have shown bulbs in which this drawback was largely avoided. In these instances a very small bulb, containing a refractory button, was mounted in a large globe, and the space between the walls of both

Fig. 30.

SHOWING THE EFFECT OF CONFINING THE GAS AROUND THE ELECTRODE.

was highly exhausted. The outer large globe remained comparatively cool in such constructions. When the large globe was on the pump and the vacuum between the walls maintained permanent by the continuous action of the pump, the outer globe would remain quite cold, while the button in the small bulb was kept at incandescence. But when the seal was made, and the button in the small bulb maintained incandescent some length of time, the large globe too would become warmed. From this I conjecture that if vacuous space (as Prof. Dewar finds) cannot convey heat, it is so merely in virtue of our rapid motion through space or, generally speaking, by the motion of the medium relatively to us, for a permanent condition could not be maintained without the medium being constantly renewed. A vacuum cannot, according to all evidence, be permanently maintained around a hot body.

*(To be continued.)*

## PROCEEDINGS OF SOCIETIES.

### Société Internationale des Electriciens.

THE ordinary meeting of the Société des Electriciens took place on July 5th, M. RAYMOND being president.

The Secretary, M. SABOURAIN, first read the report of the last meeting, and then M. HILLAIRET gave an account of the works received, and presented some new members.

M. LEJEUNE then contributed a paper on a portable apparatus for the rapid measurement of insulation. This apparatus consists of a magnet galvanometer, and a series of standard resistances with shunt. In a special case is a battery of cells capable of giving 110 volts. The method employed is the deviation method. This apparatus, constructed by the firm of Ducretet, enables us to measure insulation resistances of from 90 to 100 megohms.

M. F. GODFROY was to have spoken about the discharging and compensating instruments for telegraph lines of great capacity, but, being indisposed, M. NERVILLE appeared in his stead and gave a complete description of the present organisation of the Central Laboratory. At the entrance, on the right, is the engine room, consisting of a large hall with rails laid on the ground. In this hall are placed a 10-horse power gas motor and a steam engine of 25 horse-power. On the left is the accumulator room, containing three batteries, which may be coupled in series or in quantity. We can thus get 216 volts and 25 ampères, or 675 ampères and 8 volts, as well as all the intermediate couplings. These renderings are supposed to be obtained at 1 ampère per kilogramme; but, in certain cases, we can go as far as 2 ampères per kilogramme. In the room called the ampère room there is a standard ampère on the Pellat system; as it has a known resistance the differences of potential can be measured. In the volt room a Deprez and D'Arsonval galvanometer is in readiness to measure the differences of potential by the high resistance method. Some small cases of accumulators supplied by the Société des Métaux enable voltages to be obtained varying up to 1,000 volts. A special room is devoted to insulation resistances. A battery of Leclanché cells enables us to attain 1,000 volts; a Thomson galvanometer is in readiness for measurements. A special room is devoted to the measurement of conductivities; a Wheatstone bridge and a Thomson bridge are mounted for this purpose. In the powerful current room are a Deprez-Carpentier galvanometer capable of measuring from 0 to 100 ampères, and two Thomson balances from 100 to 500 ampères. On the ground floor is the photometry room, containing one Bunsen photometer and one Mascart photometer. On the first floor we find first an ohm room, containing a standard ohm, constructed at the Pavillon de Breteuil and

correct to within about $\frac{1}{100000}$th. We next come to a room for the measurement of capacities. The measuring instruments for alternating currents are not yet installed; the laboratory possesses no apparatus for this purpose. M. de Nerville took this opportunity of appealing to the generosity of electricians to supply this want.

At the conclusion of the sitting M. Hillairet quoted a very curious electrical experiment on the cementation of steel. M. Garnier placed, facing one another, a rod of steel, 20 millimetres in diameter, and a carbon of retort carbon of the same diameter; the two rods were separated by a layer of charcoal. The steel was put into communication with the negative pole and the carbon with the positive pole. The whole was placed on a furnace and the blast set going, with a difference of potential of 7 volts and an intensity of 55 amperes for 3 hours, traces of cementation were observed in the steel. The temperature was 1,500°. By lowering it to 1,000°, after 3 hours, the same cementation was obtained as would have been obtained under ordinary conditions in ten times 24 hours. If we substitute for the rod of retort carbon, a bar of steel, the difference of potential falls to 2·5 volts, and the bar of steel no longer shows any traces of cementation.

## NEW PATENTS - 1893.

13,353. "A new or improved means of automatically regulating the brushes of dynamo-electric machines." H. O. BODEN. Dated July 10th.

13,406. "Improvements in or relating to the treatment of sodium chloride, and to the method of utilising the product in the manufacture of white lead, soda chlorine, and their derivatives." R. HADDAN. (Communicated by the Compagnie Electro-Chimique de St. Béron, France.) Dated July 10th.

13,408. "Improvements in electric batteries." J. H. MASON and A. VAN DERWERKEN. Dated July 11th. (*Complete*).

13,412. "Improvements in automatic regulators for electric generators." E. CONRADY. Dated July 11th.

13,448. "Improvements connected with or relating to meters or instruments for measuring electricity." F. H. ASCHNER. Dated July 11th. (*Complete.*)

13,469. "Improvements in electric railway signals." F. B. ASPINALL. Dated July 11th.

13,489. "An improved electric bell." B. ZEITSCHEL. Dated July 11th. (*Complete.*)

13,507. "Improvements in range-finders, and in electrical appliances for transmitting the indications of the same to a distance." A. BARR and W. STROUD. Dated July 12th.

13,533. "Safety insulated clip for extracting and replacing electric fuses." C. D. HUTCHINS. Dated July 12th.

13,551. "The production of aromatic amido compounds by means of electrolysis." H. E. NEWTON. (Communicated by the Farbenfabriken vormals Friedrich Bayer & Co., Germany.) Dated July 12th.

13,552. "Improvements in electric arc lamps." A. D. LEWIS and F. M. LEWIS. Dated July 12th.

13,568. "An improved dry electrolytical process for the production of an alloy of lead and sodium or potassium." C. T. J. VAUTIN. Dated July 12th.

13,610. "Improvements in dynamo-electric machines." A. I. GRAVIER. Dated July 13th.

13,633. "An improved electric clock." H. WUBBELER. Dated July 13th.

13,644. "Improvements in or relating to telegraphic type printing apparatus." E. MAGNIN. Dated July 13th.

13,647. "Improvements relating to galvanometers." C. L. R. E. MENGES. Dated July 13th.

13,672. "Improvements in apparatus for transmitting telegraphic, indicating, and other analogous signals or movements by means of electric currents." A. B. BROWN and W. F. KING. Dated July 14th.

13,722. "Improvements in the manufacture of ammonia, sodium, hydroxide, and chlorine, and in apparatus therefor." C. KNELLER. Dated July 14th.

13,723. "Apparatus for the electrolytic production of bleaching liquid." C. KNELLER. Dated July 14th.

13,749. "Improved means of working and controlling electric elevators." M. H. SMITH. Dated July 15th.

13,774. "A means of maintaining the human body in electrical connection with the earth." E. SPRATT. Dated July 15th. (*Complete.*)

13,779. "Improvements in telephone circuits." J. J. MOLLER. Dated July 15th.

13,792. "Fluid operated electric switches." J. J. P. CLARIOT. Dated July 15th.

## ABSTRACTS OF PUBLISHED SPECIFICATIONS, 1892.

3,631. "Improvements in the manufacture of compound and insulated wires." F. BIDTEL. Dated February 24th. The inventor takes separately a core and a sheathing and combines these in a draw plate or rolling train, so that they become practically a uniform mass, the sheathing, which consists preferably of a metallic or other strip or strips, being drawn or rolled in one or more layers over the core, the result being that it is possible to produce wire of extreme degrees of fineness. 1 claim.

6,007. "Improvements in or connected with cells for electrolysing chloride solutions." T. PARKER and A. E. ROBINSON. Dated March 28th. Claim:—In or for cells for electrolysing chloride solutions an anode composed of, or containing phosphide of chromium substantially as described.

9,346. "Apparatus for the production by electrolysis of chlorine and alkalies." C. KELLNER. Dated May 17th. Has for its object to obviate certain drawbacks, by the peculiar construction, and by the special selection of the material of which the decomposing apparatus is constructed. 11 claims.

9,347. "Process for the separation of the alkali obtained by electrolytical decomposition of halogen compounds from the electrolyte which has not been decomposed." C. KELLNER. Dated May 17th. Consists in separating the incompletely decomposed electrolyte coming from the decomposing apparatus, after having been deprived of crystals and evaporated so far as advantageous, from the ion (alkali) contained therein, by systematic displacement, so that the said ion is obtained in an almost pure condition, and the entire quantity of the undecomposed residual electrolyte which is now separated, is returned into the cycle. 1 claim.

9,883. "Improvements in commutator brushes for dynamos or electric motors." W. P. THOMPSON. (A communication by C. L. Coffin, of America.) Dated May 24th. Claim:—A commutator brush consisting of a strip or strips of perforated sheet metal.

9,947. "Apparatus for use in insulating joints in insulated electric conducting wires." R. HADDAN. (A communication from abroad by A. Grammont, of France.) Dated May 26th. Claim:—The machine adapted to receive a cable, to soften the insulating material and compress the same upon and over a joint or denuded place in said cable and insulate the same, substantially as set forth.

9,983. "Improvements in the method of and apparatus for propelling vehicles upon railways by electricity." W. P. THOMPSON. (Communicated by E. E. RIES and A. H. Henderson, of America.) Dated May 26th. Consists in the use of a generator of very high potential alternating currents, which are carried by well insulated underground conductors along the line of the road, at any distance from the same, and at any depth below the surface of the road. These line conductors are tapped by a number of multiple arc branches in each of which is included the primary coil of an inductional converter, the secondaries of which yield currents of very low potential, but of correspondingly great volume, and each secondary coil is or may be connected with a separate track line, composed of heavy insulated conductors, disposed under, but as closely as practicable to the surface of the road bed, parallel to and preferably between the rails of the railway. 22 claims.

10,133. "Improvements in or relating to insulators for the support of overhead electrical conductors." M. N. BRANDAO. Dated May 27th. Consists of an inverted double bell of porcelain, or other suitable dielectric, which is cemented on to the end of an elbow shaped wrought-iron bracket that is fixed to the post. To the top of the insulating bell is cemented a metal cap on which are fixed or formed two studs, and on these studs are mounted two cams or eccentric segments with grooved edges, so formed as to nip between them the wire conductor. The upper ends of the studs are formed with screw threads, the one being right handed and the other left handed, and upon these are screwed nuts. 4 claims.

10,367. "Improvements in connections and terminals for electric and other wires and cables." H. SANCHE. Dated May 31st. Has for its object to provide a terminal for electrical wires, with which the denuded portion of the wire may be readily and easily connected and in which it may be held with the best possible contact and with complete protection to the cut, or frayed end of the insulating covering. 10 claims.

10,762. "Improvements in incandescent electric lamps." E. E. WEAVER and G. B. MANYPENNY. Dated June 7th. Consists of a device or appliance for increasing the illuminating power or brilliancy of an incandescent electric lamp, comprising a reflecting body, in form irregular, square, or elliptical, and disposed between or about the filament of the lamp; and further consists of an incandescent electric lamp having a hollow reflector of irregular, square, or elliptical cross-section, forming the inner wall of the vacuum chamber of the lamp and filament, the two parts of which are disposed in proximity to the points or ends of the reflector and supported by electrodes sealed to the socket of the lamp, the construction and arrangement of the hollow reflector being such that a supply of air is permitted around about the internal surface, whereby overheating or other damage to the reflecting body of the lamp is prevented. 2 claims.

11,032. "An improvement in insulating supports for electrical conductors led in culverts." J. T. HARRIS. Dated June 11th. The support is a tube of porcelain or ceramic material of approximately semi-circular section with notches in its arched crown in which the conductors are laid, being thus separated by the portions of arch between the notches. The two sides project a little below the bottom, forming two ribs, which rest on the floor of the culvert. 1 claim.

12,191. "Improvements in electric railways." B. J. B. MILLS. (A communication from E. H. Johnson, of New York.) Dated June 30th. The object of the present invention is to provide a construction for the conduit, the current collector and the devices for keeping the conduit clean, whereby the loss by breakage from one side of the circuit to the other, due to the presence of moisture or foreign bodies, is reduced to a minimum, and whereby, the conductor and the conduit itself may be kept clean and continuously freed from moisture and from dust, snow and other foreign materials, liable to impair the efficiency of the travelling contact and obstruct its passage. 3 claims.